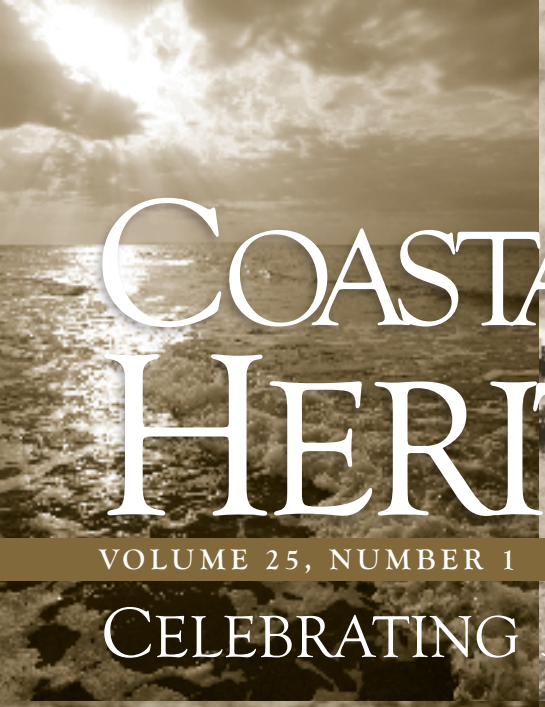
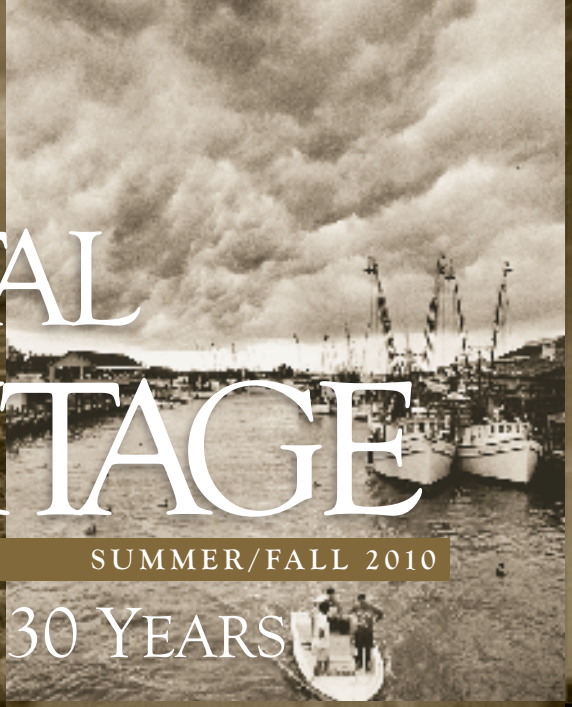
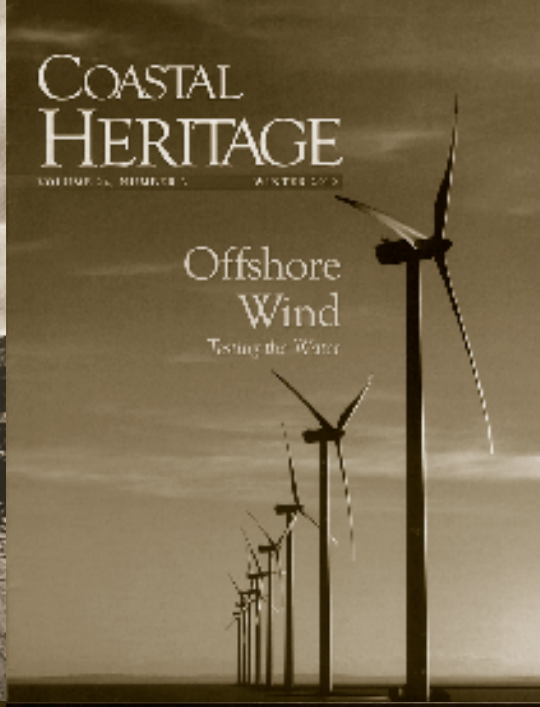
Coastal Heritage

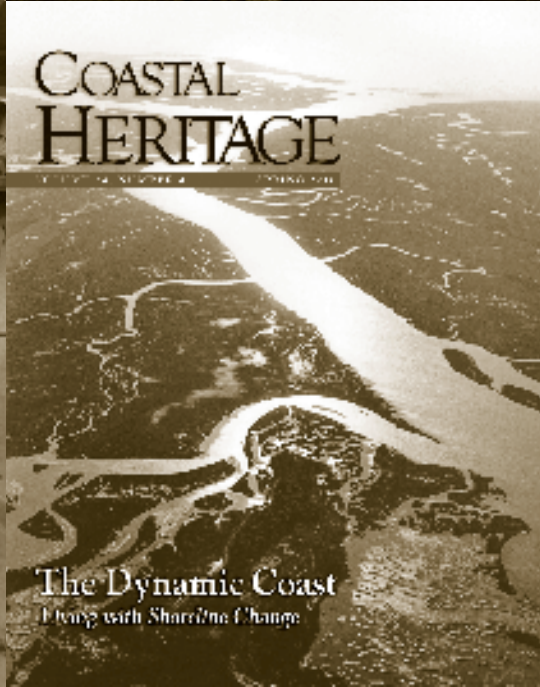
VOLUME 25, NUMBER 1 SUMMER/FALL 2010

Celebrating 30 Years









CONTENTS

THE COVER:

John H. Tibbetts has been writer and editor of *Coastal Heritage* since 1989, covering topics ranging from early Carolina history and culture to hazard resiliency, climate change, and alternative energy. Wade Spees has shot *Coastal Heritage* photographs since 1991, lending a unique perspective and award-winning talent to our team. John's ability to convey complex subject matter in an easy-to-read style combined with Wade's knack for capturing the essence of the moment results in a high-quality publication we hope readers will enjoy for many years to come. SFH

Coastal Heritage *issues dating back to Spring 1997 are available online at www.scseagrant.org/Sections/?cid=82. Issues published prior to 1997 are available upon request by contacting the Consortium at (843) 953-2078 or emailing the editor.*

Sea Grant
S.C. Sea Grant Consortium

Celebrating 30 Years of Science
Serving South Carolina's Coast

Coastal Heritage is a quarterly publication of the S.C. Sea Grant Consortium, a university-based network supporting research, education, and outreach to conserve coastal resources and enhance economic opportunity for the people of South Carolina. Comments regarding this or future issues of ***Coastal Heritage*** are welcomed at John.Tibbetts@scseagrant.org. Subscriptions are free upon request by contacting:

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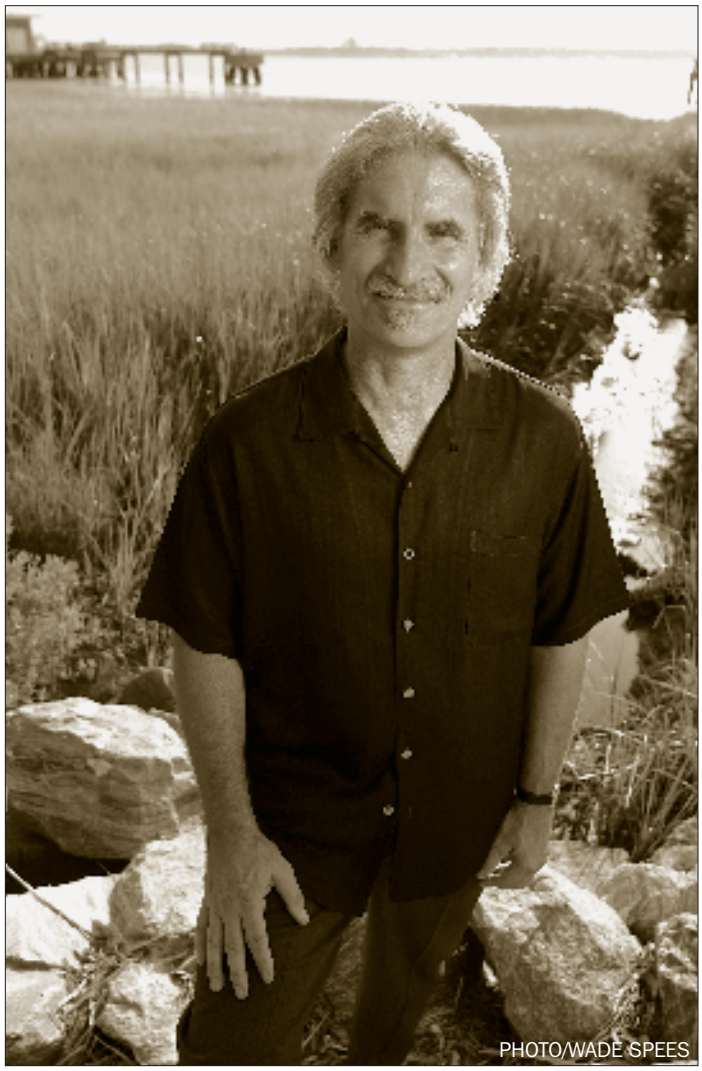

PHOTO/WADE SPEES

Thinking of the 30 years since the S.C. Sea Grant Consortium opened its doors, and reviewing past issues of *Coastal Heritage*, I continue to be surprised at "the ways in which the environment, the economy, and the culture of the region interact" and how these interactions over time continue to "provide South Carolinians with needed insight for today's decision making."

Those quotes are by John M. Armstrong, the Consortium's first executive director, from the first issue of *Coastal Heritage*, published in 1982. At that time, the Consortium was just developing its niche, finding its sense of purpose, and honing its abilities to contribute timely information about relationships among South Carolinians and our coastal lands and waters, culture, and history.

Our world is changing quickly, of course. Technology continues to reshape our lives. Resort tourism is altering the face of our shorelines and coastal ecosystems. Globalization is transforming our commercial fisheries, our ports, and our economy. Population growth, meanwhile, challenges us to find places for newcomers to live and work. Indeed, South Carolina's coastal environment is in a constant state of flux. Even the title of the Consortium's strategic plan ("Valuing Resources, Adapting to Change") reflects this principle.


Coastal Heritage

***1982. The first issue of* Coastal Heritage**

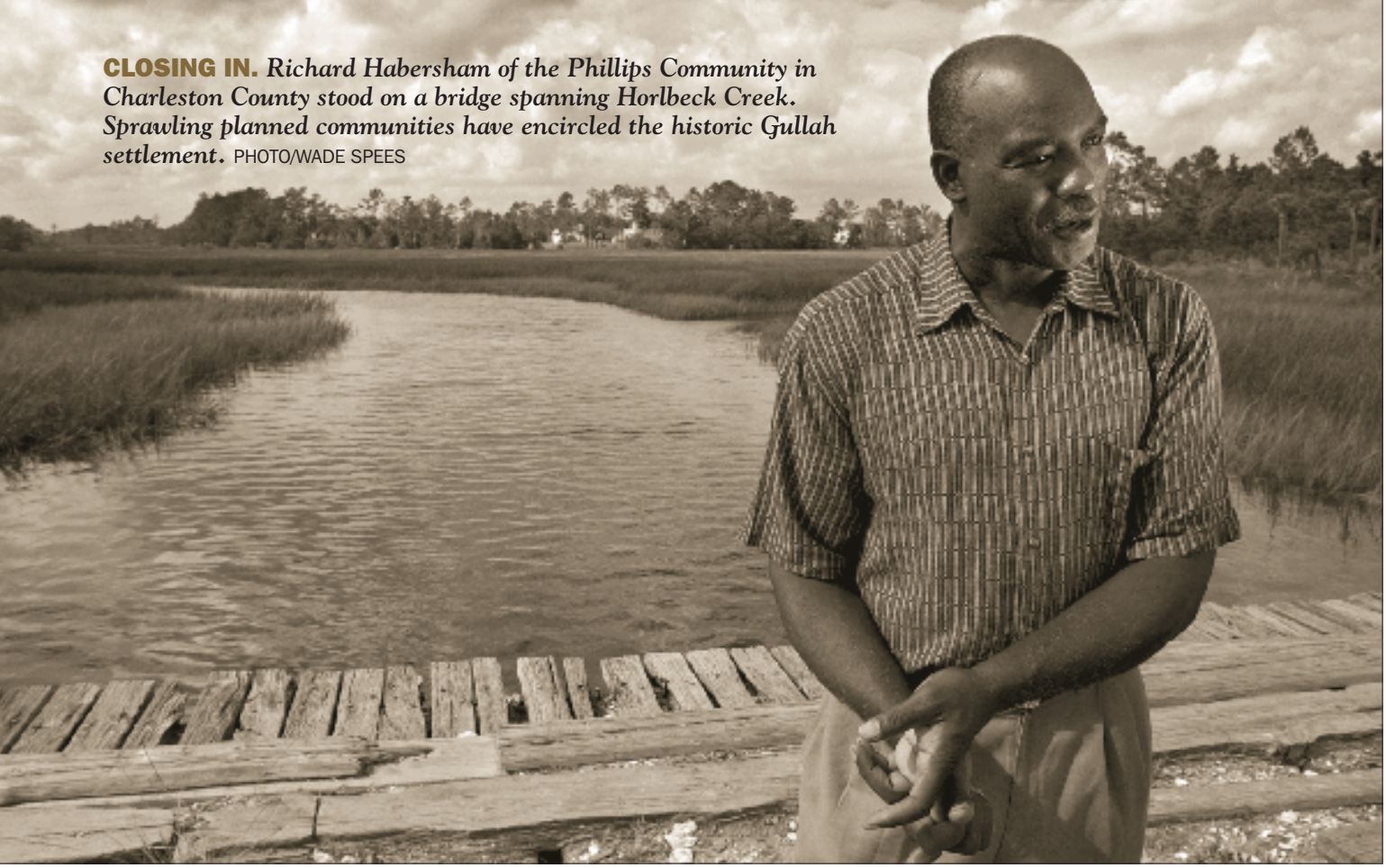
Still, some things remain the same. The South Carolina coast has a strong historical and cultural foundation, and much of that foundation is based on sensitivity to and reliance on the natural environment. For generations, the rice plantations of colonial and antebellum eras depended on rich land carved out of coastal swamps. Today, many of these former rice plantations are special landscapes held in private and public hands for traditional uses. The old rice fields, moreover, remain unique lowcountry features. And within former plantations' boundaries are many historic rural settlements that continue to thrive today.

Hurricanes and coastal storms have affected the state's economy and environment for centuries. Our beaches and coastal shorelines continue to meander and shift as they have been doing for millennia. Today, though, we are learning from past experiences of storms and shoreline change, gaining insight in how residents and decision makers navigate the whims of Mother Nature and human nature.

These themes are as important to us today as they were 30 years ago, as shown by topics that we have covered in *Coastal Heritage.* In this 30th anniversary issue, we look back on the significance of relationships between the human and natural environments in our state. We also venture a brief look to the future. These issues will continue to manifest themselves in multiple ways, and offer us challenges that we will have to meet.

I hope you enjoy reading the following pages. Thank you for allowing us to serve you for the past 30 years, and we look forward to doing so into the future.

M. Richard DeVoe
Executive Director



CLOSING IN. *Richard Habersham of the Phillips Community in Charleston County stood on a bridge spanning Horlbeck Creek. Sprawling planned communities have encircled the historic Gullah settlement.* PHOTO/WADE SPEES

The Lowcountry—Where History Lives

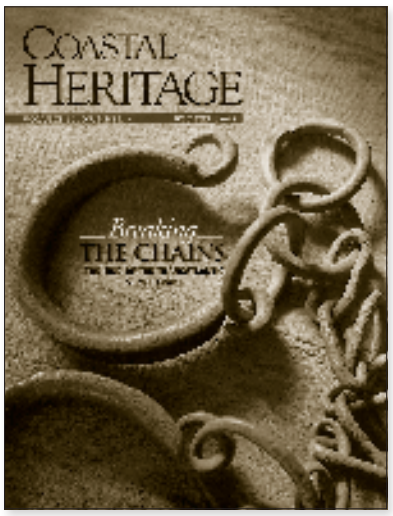
"The past isn't dead. It isn't even past." That's William Faulkner, in 1951, describing what history often means in this corner of the world, the Deep South, where long-ago events can seem very close at hand.

The great national tragedies of slavery and the Civil War were played out mostly on southern soil, and for generations white southerners told their version of the American story in schoolrooms, museums, historic districts and plantations, antebellum homes, forts, and battlefields. They celebrated their ancestors' roles in the nation's narrative by preserving documents and artifacts, writing memoirs and histories, and by sustaining distinctive manners and traditions.

Black southerners have faced far more difficulty in keeping their history alive. Generations of African-Americans passed down folklore, religious beliefs, a cuisine, language, and especially their musical traditions out of which they created the incomparable art forms of southern spirituals, blues, and jazz. Yet their contributions to the nation's history and culture were often driven into the background, lost, misunderstood, or forgotten.

Until the mid-1990s, tour guides at lowcountry historic mansions and plantations avoided any mention of slavery. Instead, visitors were told of South Carolina's rice planters, who formed the most powerful aristocracy in North America. Before cotton became king in the Deep South, rice was its most valuable commodity. Rice fields became known as South Carolina's "gold mines."

Beginning in the 1720s, rice planters drove African slaves to cut down cypress-gum forests in lowcountry swamps and build earthen dams, creating ponds as reservoirs. Water from rainfall or natural springs in inland swamps could be stored there. Adjacent to reservoirs, slaves built additional impoundments, which became rice fields. Within earthen dam walls, planters installed wooden devices called "trunks" that could be opened and closed



2008. Commemorating the 200th anniversary of the end of the transatlantic slave trade.

to manipulate water flow between reservoirs and rice fields.

Slaves would begin sowing rice in April or May, pressing seeds coated with clay into the mud with their heels, and then fields were flooded to allow seeds to germinate. In June, slaves drained fields to hoe or pick weeds. After releasing water from reservoirs, slaves flooded the fields again to provide moisture for rice plants.

By the 1750s, innovative planters constructed vast networks of rice fields along tidal rivers, which provided more reliable irrigation resources. These plantations became the nation's most technically sophisticated agricultural operations of their time, allowing owners to amass great fortunes.

Some slaves were already expert rice growers by the time they reached the lowcountry. They brought extensive knowledge of rice cultivation with them from African regions where rice had been grown for centuries. Indeed, many planters specifically sought slaves who already knew how to cultivate rice.

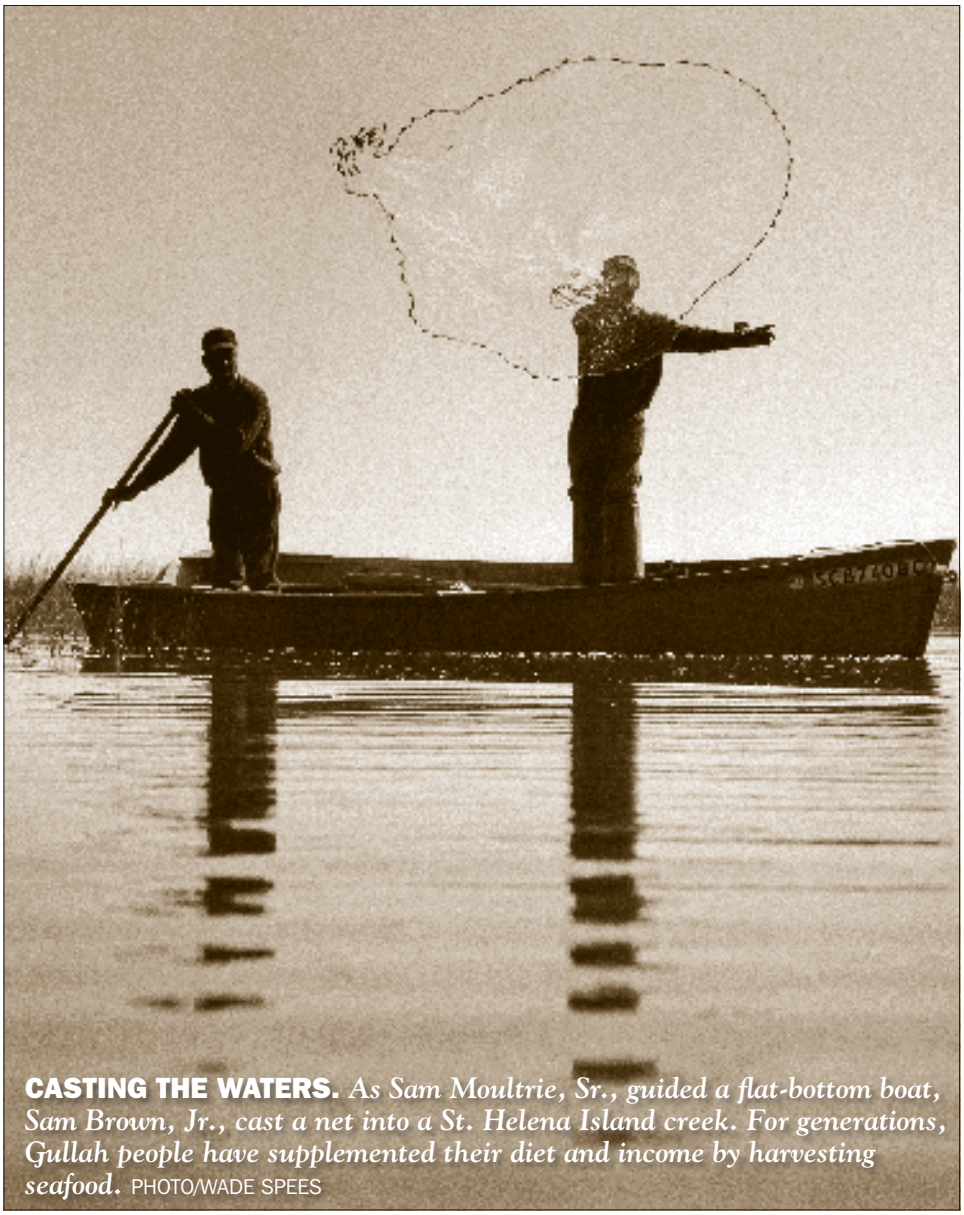
After a long history of exposure to malaria, Africans had developed a degree of resistance to this disease, which devastated whites. During the long growing season, planters fled their swampy estates, relocating to upland or beach retreats.

Lowcountry slaves on rice plantations were left alone for much of the year. They managed their own tasks in the rice fields, which provided them with flexibility over their daily lives and allowed space to create a distinctive creole culture called Gullah in South Carolina and Geechee in Georgia. Their creole language, for instance, is a blend of English words and African grammar.

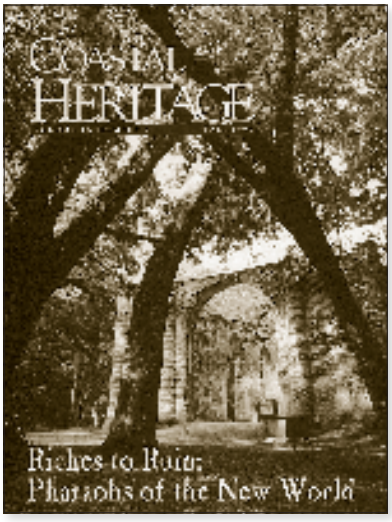
After the Civil War and a series of hurricanes, the rice industry collapsed. Bankrupt planters abandoned the countryside. Many Gullah people acquired small land plots on former plantations where they had been enslaved, working as subsistence farmers or fishermen. Some earned cash as seasonal field hands, picking cotton for white landowners who remained.

The rural lowcountry was desperately poor. Roads were bad, bridges few. Many remnant rice fields returned to the wild. Storms and erosion broke impoundment dikes, and fields filled in with vegetation, becoming cypress-gum forests once again.

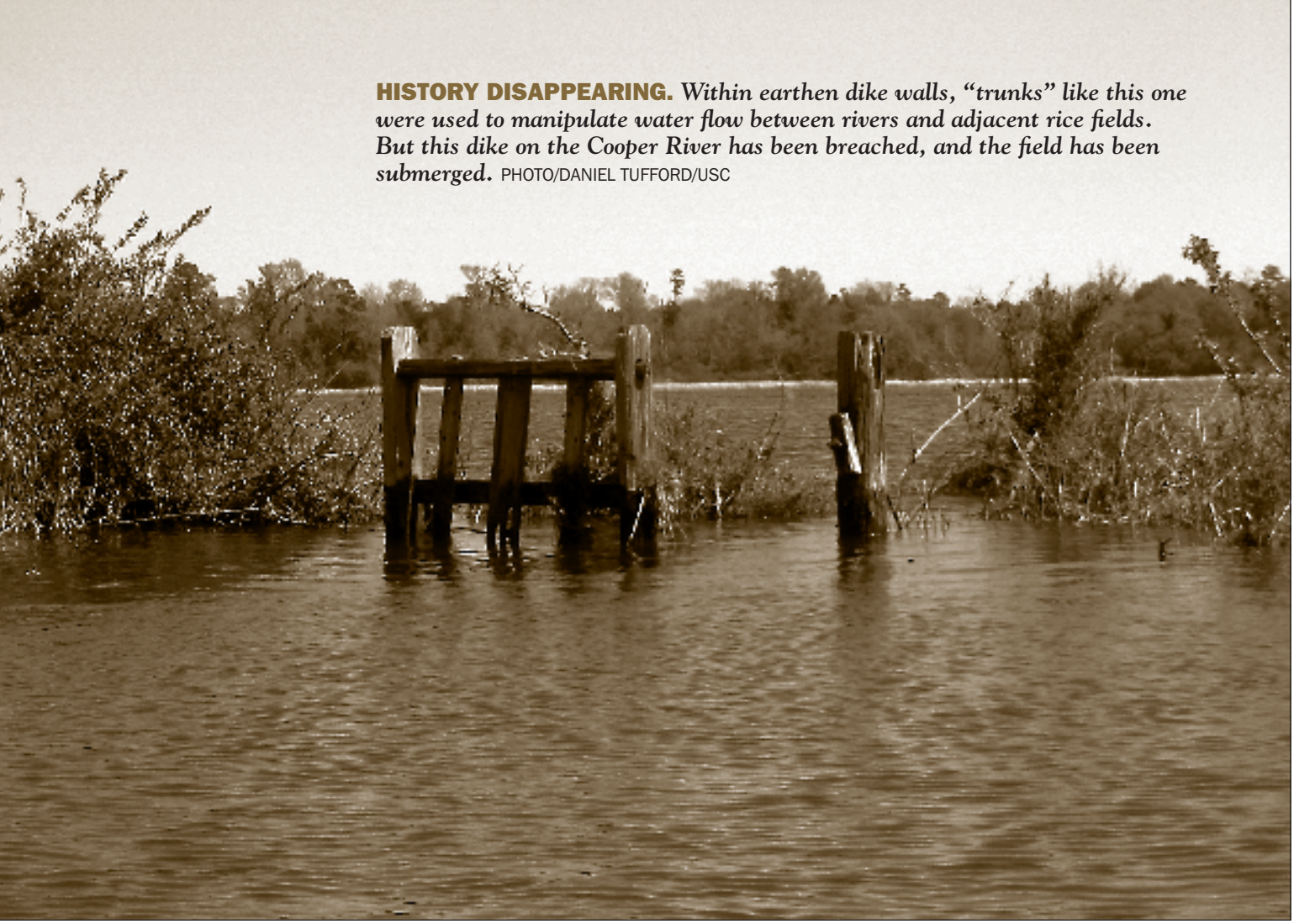
Beginning in the 1890s, wealthy northerners discovered the lowcountry, and families with names including Vanderbilt, du Pont, and Roosevelt bought bankrupt plantations for winter retreats and hunting clubs. The northern hunters who arrived in the first wave were not conservationists by today's standards. But over time some landowners began to address overhunting of migratory waterfowl and other game.



CASTING THE WATERS. *As Sam Moultrie, Sr., guided a flat-bottom boat, Sam Brown, Jr., cast a net into a St. Helena Island creek. For generations, Gullah people have supplemented their diet and income by harvesting seafood.* PHOTO/WADE SPEES



1999. The aristocrats who helped to create the lowcountry's distinctive culture and enduring conflicts.



HISTORY DISAPPEARING. *Within earthen dike walls, "trunks" like this one were used to manipulate water flow between rivers and adjacent rice fields. But this dike on the Cooper River has been breached, and the field has been submerged.* PHOTO/DANIEL TUFFORD/USC

The Santee Gun Club established game restrictions that were tougher than state and federal laws. A few plantation owners even created wildlife refuges where no hunting was allowed.

Hunting clubs and winter retreats kept many lowcountry families financially afloat. Local people worked as guides, game wardens, household staff, and laborers for northern landowners.

But the lowcountry economy suffered a crushing blow in 1920 with a severe drought and an abrupt collapse of cotton prices. In 1921, boll weevils destroyed sea-island cotton, a valuable lowcountry cash crop, and in 1922, the pests nearly wiped out short-staple cotton, cultivated in the uplands.

Many Gullah people continued to farm on sea islands and isolated mainland areas, but in the lean years of the Twenties thousands of black farmers and seasonal laborers fled the countryside. Many moved north. Others found work as longshoremen, low-wage laborers, or fishermen in Charleston and other southern port cities, although even in town many kept their Gullah culture and language.

The Great Depression and World War II brought further changes to the coast. Hunting clubs and plantations struggled financially, and many landowners eventually sold out and left. Other families visited the lowcountry so often that they stayed and assimilated into southern society.

In the 1950s, a new generation of plantation owners and managers began rebuilding earthen dikes that had surrounded former rice fields. Later, though, regulations prohibited complete rebuilding of the dikes; only existing dikes could be repaired. Today, about 70,000 acres of former rice fields remain impounded in South Carolina, and they comprise unique ecosystems along the Atlantic coast. Another 74,000 acres have deteriorated after dikes have broken, and historic fields have been returning to their natural state as swamp forests.

A Sea Grant study in the mid-1980s showed that most landowners who maintained former rice fields did so to attract migratory waterfowl in the winter. The study also reported, however, that a large abundance of other birds—from shorebirds to waterbirds to wading birds—used former rice impoundments for feeding grounds as well.

Yet many have opposed rebuilding rice-field dikes, which close off access to fish habitat.

In the mid-2000s, a team of Sea Grant scientists began studying ecological changes in historic rice fields on the upper Cooper River where dikes had broken and open-water fields were transitioning to swamp forests. A State of Knowledge report on *South Carolina Coastal Wetland Impoundments* (remnant rice fields) was completed in 2005. Written by Sea Grant researcher Daniel Tufford, a University of South Carolina

biologist, the report includes a research summary from the mid-1980s to present, prior research and policy recommendations, a summary of active research and new recommendations, and a comprehensive cited reference list.

"The rice fields are special places," said Sea Grant researcher Joe Kelley, a retired biologist at The Citadel. "We need to take a hard look at whether these [open water] habitats should be allowed to disappear."

Other lowcountry historic resources have been lost over the past three decades. As property values and taxes have escalated rapidly, plantation owners have sold properties to developers who build subdivisions, golf courses, and strip malls.

1982. In the "sickly season" from June to November, rice planters fled their swampy estates.

In 1987, a group of landowners, government officials, hunters, and environmentalists began looking for ways to conserve a vast region of river bottomlands, salt marshes, and upland forests in the Ashepoo, Combahee, and Edisto rivers basin, known as the ACE Basin.

Some landowners gave tracts outright to conservation organizations and the S.C. Department of Natural Resources. But many property owners kept lands in family hands while donating development rights to land trusts and conservation organizations in the region. In the ACE Basin and elsewhere in the lowcountry, hundreds of thousands of acres of private property have been protected in perpetuity by conservation easements.

Today, large stretches of the coast remain rural—crucial habitat for endangered species and migratory waterfowl—because of this network of private and public lands, many of which are managed for historic uses of hunting, forestry, farming, and wildlife.

But government can't afford to buy all of these remaining ecologically rich areas. Conservationists hope that additional plantation owners will donate easements to land trusts.

Meanwhile, many descendants of lowcountry slaves—the Gullah people—have struggled to hold on to family land. After the Civil War, freedmen purchased parcels of former plantations and shared them among family members, passing on land to subsequent generations. As families expanded, many parcels remained in collective ownership. Dozens of family members in many cases jointly own parcels that lack up-to-date titles. It's common for the original purchaser from the nineteenth century to be named as owner, even today. This collective family ownership of land is called "heirs' property."

Many Gullah view family land as a place of refuge, a place to come home to after they have seen the world, after serving in the military or working for decades in the North. For others, family property is a place to raise children, to grow up knowing aunts and uncles and cousins, and to spend long summers with grandparents.

"We consider land as family," said Marquetta Goodwine, an activist also known as Queen Quet, chieftess of the Gullah/Geechee Nation, who lives on St. Helena Island.

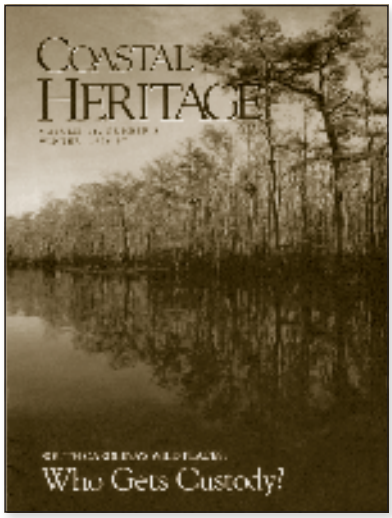
The problem with heirs' property, however, is that any heir can go before a judge to gain the value of his property. And often the only way to get that value has been to sell the entire parcel. Sometimes developers buy an interest from an heir and ask a judge to auction the entire parcel. Sales have sometimes happened so quickly that other members of the family haven't been able to respond in time.

2000. Spawned by Africa and Europe, the Gullah culture is fading in the modern world.

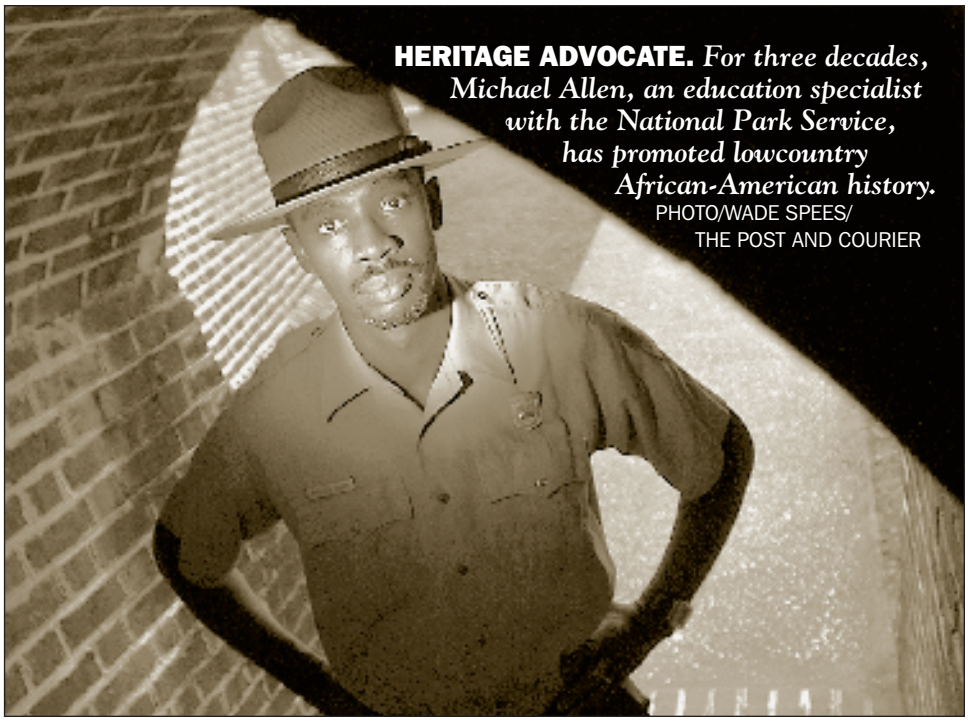
A 2006 law passed by the South Carolina legislature provides that family members have 10 days to identify and notify all potential heirs of a possible sale, though it's common for numerous heirs to live far away and to be out of contact. The law also provides family members with the right of first refusal to buy the share of a fellow family member who wants to sell, but money can be hard to raise on short notice.

Heirs' property remains a problem for African-American communities, said Michael Allen, an education specialist with the National Park Service, who has long promoted Gullah history. "They don't want to put the land in one person's name because that person could

2006. The African contribution to the lowcountry rice industry.



1996-97. Conservationists seek to expand protection of the lowcountry's wild places.



HERITAGE ADVOCATE. *For three decades, Michael Allen, an education specialist with the National Park Service, has promoted lowcountry African-American history.*
PHOTO/WADE SPEES/
THE POST AND COURIER

go and sell it overnight. They think they're safer with heirs' property. But I think they should have their name on the title and not someone's who died in 1890."

Lost connections to family land and culture, plus racial integration and greater economic opportunities for African-Americans, hastened the decline of folk traditions in the 1960s and 1970s. Some elders still speak Gullah, but their grandchildren regard it as quaint and don't learn the language, which has been threatened with extinction.

But by the mid-1990s, historians, educators, and activists revived public interest in Gullah. Drayton Hall and Middleton Place, two nationally known plantations, created exhibits and other programming about African-American history, showing how slaves lived and worked there. The Penn Center on St. Helena Island and the Avery Research Center for African American History and Culture have worked to raise awareness of Gullah people's contributions to South Carolina.

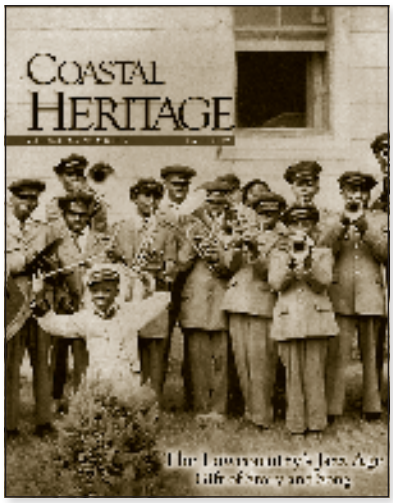
The National Park Service, in particular, has been a leader in re-introducing Gullah folklife to visitors and lowcountry residents. Today, the park service is developing a management plan for the Gullah/Geechee Cultural Heritage Corridor, which extends from Wilmington, North Carolina, southward through coastal South Carolina, to Jacksonville, Florida. The planning effort is expected to take three years.

The corridor is part of a sustained effort of African-Americans to tell the complete lowcountry story. Today many Gullah communities are embracing land-protection and cultural-preservation efforts, realizing that their history is revealed in family and community traditions, in land use, stories, music, food, and language.

"There were generations of people who were told that they were not part of the American journey," said Allen. "We want Gullah people to understand that their ancestors helped to shape the destiny of this country."

The Gullah helped build the lowcountry, both urban and rural, as we know it today. The grand antebellum homes of Charleston, Beaufort, and Georgetown were largely constructed by Gullah labor. The Gullah constructed and maintained the lowcountry's once lucrative rice plantations, many of which were broken up after the Civil War, purchased in small parcels by freedmen, and passed on to subsequent generations. Other bankrupt plantations were bought by northerners as winter retreats, prized for their deep forests and marshlands that now comprise a necklace of habitat strung along the coast from the Savannah River to Winyah Bay and up the Black, Pee Dee, and Waccamaw rivers.

Three decades ago, large stretches of the rural lowcountry were untouched by development. Since then, however, the region has experienced explosive growth. Now landowners, communities, nonprofit groups, and government agencies are collaborating to highlight the importance of lowcountry culture and traditional land uses. When the economy fully recovers, these collaborations will need to become stronger to cope with the next generation of sprawling growth.



2009. Gullah people are telling their own story of contributions to American culture.

DOCKING SPACE. *A shrimp boat eased into a Gay Seafood Company's wharf on St. Helena Island. After years of financial stresses, numerous lowcountry seafood wharves have shut down.* PHOTO/WADE SPEES

Seafood Producers Fight Global Competition

The late Junior Magwood used to reminisce about the brutal old days of the early 1940s when he started apprenticing for his cousin. Magwood was just 14, working on a converted freight boat in search of shrimp, dragging the sea bottom with nets that had to be hauled up without benefit of winches, using just block and tackle—and every ounce of his strength.

Backbreaking labor on shrimp boats was a tradition in South Carolina. In 1880, lowcountry fishermen managed to land 630,000 pounds of shrimp, using only seines and cast nets.

Weighing only 120 pounds as a teenager, Magwood often got injured, severely pulling muscles, until he learned how to lift the nets properly.

"You couldn't do but three drags a day because by then you were wore out," Magwood said. "The nets were heavy with water and jellyfish. Filled your net with that jellyfish."

The Magwood family helped build South Carolina's seafood industry in the decades after World War II. By the end of the twentieth century, fishermen were

2000-01. Would you notice if South Carolina commercial fishermen disappeared?

running sophisticated, high-tech enterprises. In 65-foot boats, shrimpers were hunting down their prey with depth finders and global positioning systems, dragging large nylon nets across the sea bottom, and pulling in catches with hydraulic winches.

Yet lowcountry fishermen at the start of the twenty-first century were facing a perfect storm of competitive, financial, and regulatory pressures: rising fuel, labor, insurance, and maintenance costs; public concern about the effects of trawling on the sea bottom and turtles; increasingly tough regulations to sustain fishery populations and protect the marine environment; rapidly escalating value of waterfront properties; and gigantic volumes of imported seafood that drove down prices that local fishermen received for their catches.

Competition from low-cost imports remains the greatest challenge facing

1982. A brief history of fisheries in S.C.

nearly all U.S. seafood producers, both farmed and wild caught.

"Imports are coming in from countries that aren't meeting the same regulatory requirements that we have," said Sea Grant researcher John Mark Dean, professor emeritus of marine science at the University of South Carolina. "You can buy imported grouper at less than you pay for domestic grouper. And the imported grouper would not be permitted to be landed by our fishermen because they are far smaller than our minimum size."

Meanwhile, resource managers have tightened harvesting rules on many stocks because of past overfishing. Some stocks are coming back, but not quickly enough to provide a living for many fishermen.

About 25 percent of major U.S. fish stocks are overfished. In the U.S. South Atlantic region, some snapper and grouper stocks were heavily fished from the mid-1970s to the early 1990s.

2004. Lowcountry fishermen struggle to compete with cheap imported seafood.

The snapper-grouper fishery in the U.S. South Atlantic is a complex of 73 reef species, including snappers, groupers, jacks, porgies, tilefish, grunts, and sea basses. Some overfished species include speckled hind, Warsaw grouper, misty grouper, yellowedge grouper, snowy grouper, golden tilefish, sand tilefish, and blueline tilefish. Today these species have federal management regulations in place to limit harvest and to bring species back up to maximum sustainable yields.

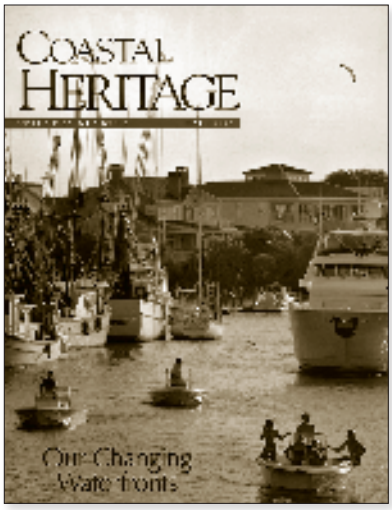
In the early 1990s, the South Atlantic Fishery Management Council (SAFMC), which manages fisheries in federal waters three miles to 200 miles offshore of the Carolinas, Georgia, and the eastern coast of Florida to the Keys, instituted tough management measures for overfished species, including trip limits, species limits, size limits, gear regulations, seasonal closures, total-allowable-catch limits, a commercial limited-entry program for some species, and quotas. SAFMC has designed new marine-protected areas in the region and is establishing a new round of tougher rules on the snapper-grouper fishery. With the reauthorization of the Magnuson-Stevens Act, the annual catch limits for each species must be established by 2011 to help ensure sustainability for the future.

At the same time, there are fewer and fewer places for sizable fishing boats to dock. Some seafood packers are reaching retirement age or growing weary of the business. A sensible financial option for them is to sell their waterfronts to the highest bidder. Upscale condominiums, million-dollar homes, and expensive restaurants are replacing the weather-beaten waterfronts where fishermen would buy fuel and ice, dock their vessels, receive dealer credit, and sell their catches—key ingredients of the seafood industry's infrastructure.

There's growing concern about the future of water-dependent businesses, including fishing, seafood wharves and seafood processors, shipyards, kayak operators, head boats, tour boats, and others. Can they survive the juggernaut of increasing land values and competing uses?

The recent economic crisis slumped land values along the coast. But eventually prices will rise again, and as a result many working waterfronts could be lost over the next decade or two.

Local governments often don't know where to begin to save a traditional waterfront. That's why a handful of states have stepped up with planning advice and funding for conservation.

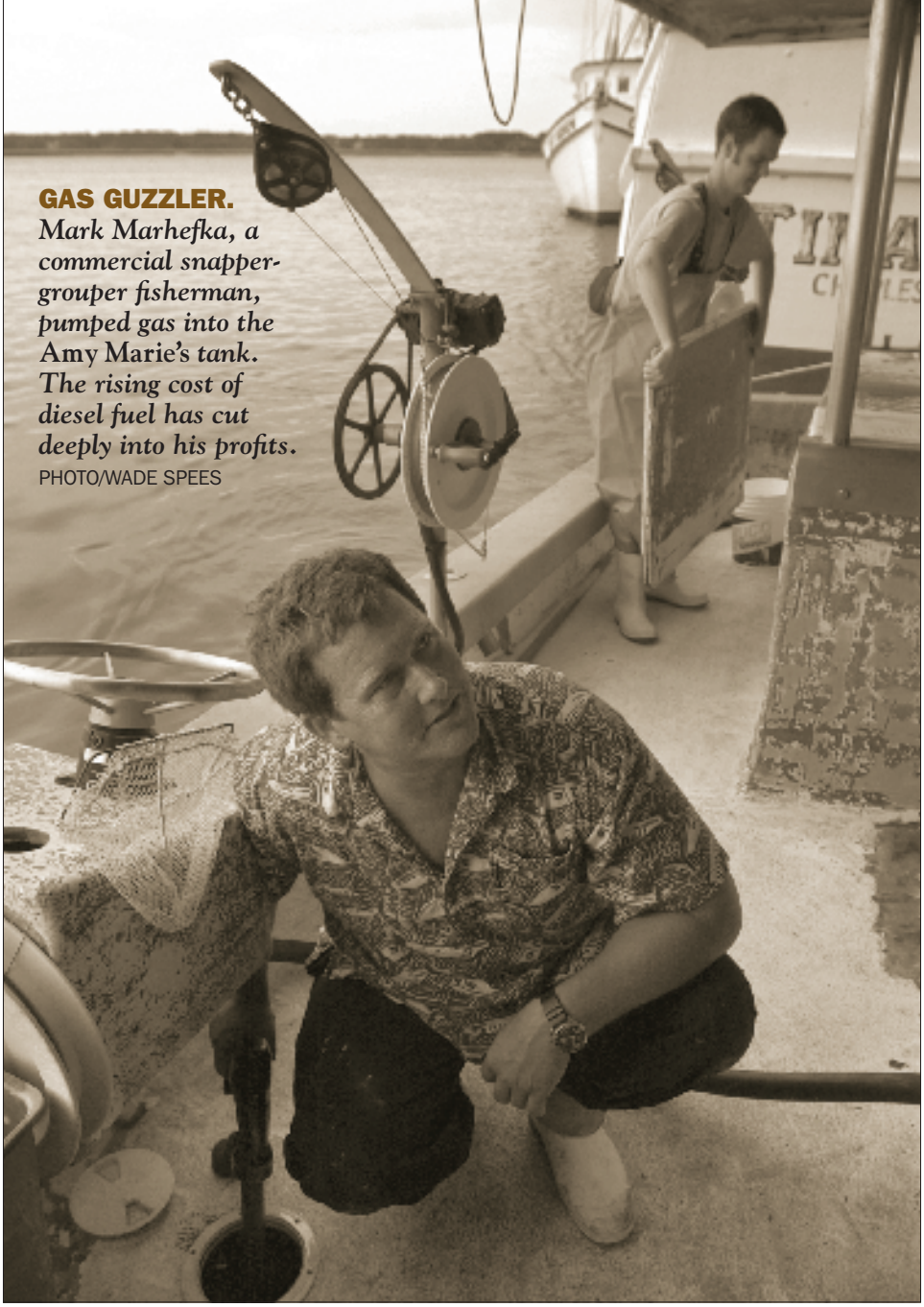


2007. Surging demand for waterfront homes is diminishing water access for fishermen and boaters.

Florida is a national leader in this arena. The state's Waterfronts Florida Partnership Program provides technical assistance, training, and limited grant funds to localities that aim to protect waterfronts. The Florida program is loosely modeled after the Main Street Program, which helps local residents establish a community "visioning" process. In 2005, the Florida legislature passed a law requiring coastal localities to consider how to protect public access and working waterfronts as part of the comprehensive planning process.

Also in 2005, Maine voters passed a state referendum to allocate $2 million in bond funds to help localities and local nonprofit organizations purchase development rights on working waterfronts.

Protecting working waterfronts



GAS GUZZLER. *Mark Marhefka, a commercial snapper-grouper fisherman, pumped gas into the* Amy Marie's *tank. The rising cost of diesel fuel has cut deeply into his profits.* PHOTO/WADE SPEES

begins at the local level. "Community members have to come together and decide whether a historic use of a working waterfront is what they want there in the future," said Shawn Kiernan, a regional planner with the Maryland Department of Planning. "They have to ask, 'Do we want these water-dependent uses to continue?' If the community says yes, then you can figure out the options."

Today, the greatest challenge for lowcountry shrimpers is competition from huge volumes of inexpensive, imported, farm-raised shrimp. The reality is that farming shrimp in the developing world is generally much less expensive than hunting for crustaceans in large, diesel-fueled boats that drag heavy nets along the sea bottom.

During the 1970s, overseas shrimp farmers began following the model of intensive agriculture—that is, cultivating a single crop species for high yields, using heavy doses of chemicals, large amounts of water and feed, and sophisticated breeding techniques. Shrimp is still the high-yield aquaculture crop of choice in South America and Southeast Asia, where farmers can grow two or three crops a year.

Aquaculture is the fastest-growing food-production in the world, and in the future it could provide the largest source of fish and shellfish for human consumption. But while aquaculture has grown swiftly, it has also experienced growing pains, including devastating animal diseases, which don't affect human health but can cause production crashes and epidemics.

These disease problems were particularly devastating in overseas shrimp farms beginning in the 1990s. Shrimp aquaculture had grown far too quickly in some developing countries, experts say. In the boom years, governments were so eager to encourage lucrative shrimp farms that they failed to establish or enforce water-quality and other environmental protections.

To reduce stress on their shrimp stocks, overseas farmers would routinely release about 20% of each pond's water into estuaries, and in some cases viruses escaped into coastal waters. Then neighboring shrimp farmers pumped in untreated water from the same source. Epidemics raced around the world in infected broodstock, post-larval shrimp, and market-ready shrimp.

"When you increase the intensity of production, you generally increase the potential for catastrophic diseases," said Jack Whetstone, recently retired aquaculture specialist with the S.C. Sea Grant Extension Program.

In the United States, aquaculture is tightly watched and regulated, and operations here have been much cleaner than many overseas. Even so, overseas viruses slipped into U.S. shrimp farms, including some that had been sited on the South Carolina coast, causing

1996. To ensure seafood supplies, governments must better manage wild stocks and encourage sustainable aquaculture.

production crashes and financial losses.

"Diseases are part of the regular growth of a livestock industry," said Whetstone. "We should've better anticipated the virus problems in shrimp aquaculture," though some U.S. farmers and researchers were aware of the catastrophic disease threat and were working to address it.

Since then, many farmers and researchers around the world have refined biosecurity systems and best-management practices in shrimp aquaculture. But it was too little, too late for many lowcountry shrimp farmers who couldn't rebound financially from virus debacles.

The challenge now for the lowcountry seafood industry is to reach out to consumers and show that South Carolina's products are a best buy in quality. Amber Von Harten, fisheries specialist with the S.C. Sea Grant Extension Program, said that the state's seafood businesses are looking for innovative ways to process and market both wild-caught and cultured products.

2001. After animal viruses raced around the world, aquatic farmers and researchers found ways to contain them.

In March 2009, five shrimpers from South Carolina traveled to Alaska to learn how spot prawn and salmon fishermen there address fishery-management, infrastructure, and business challenges.

Alaska's salmon fishermen have organized industry associations to help create state and federal support, develop innovative marketing strategies, and work with fishing communities to create much needed processing, storage, and distribution facilities and networks.

The South Carolina shrimpers visited fishing communities of Juneau and Petersburg, Alaska, where they attended workshops on topics such as direct marketing to consumers, fisheries cooperatives, and building leadership skills. Shrimpers met with state government officials in the governor's office and the Department of Commerce to learn about state and federal programs that help fishermen improve their business practices.

Von Harten collaborated with the Alaska Sea Grant Advisory Program to organize the event.

This project was supported by a grant to Clemson University and the S.C. Sea Grant Extension Program from the U.S. Department of Agriculture, Trade Adjustment Assistance, Intensive Technical Assistance Program.

"The trip was an eye-opener for the fishermen," said Von Harten. "Seeing firsthand the seafood processing and marketing operations there, and interacting with other commercial fishermen, helped them understand they are not alone in challenges they face as an industry. In Alaska, the industry was able to overcome challenges through coordinated efforts in industry leadership, fisheries policy, and marketing and branding. Participants came back energized to bring the South Carolina seafood industry together to work toward common goals for promoting the state's seafood."

Based on lessons learned from the Alaska Fisherman Exchange, the shrimpers sought assistance from the S.C. Seafood Alliance and other partners to organize and host the inaugural S.C. Seafood Summit.

The summit brought together wild-caught fishermen, aquaculture producers, and seafood businesses. More than 90 attendees learned about the current state of fisheries in South Carolina, global outlooks on fisheries and aquaculture production, and highlights of successful seafood business and marketing initiatives in North Carolina. Attendees identified actions that could sustain wild fisheries and aquaculture.

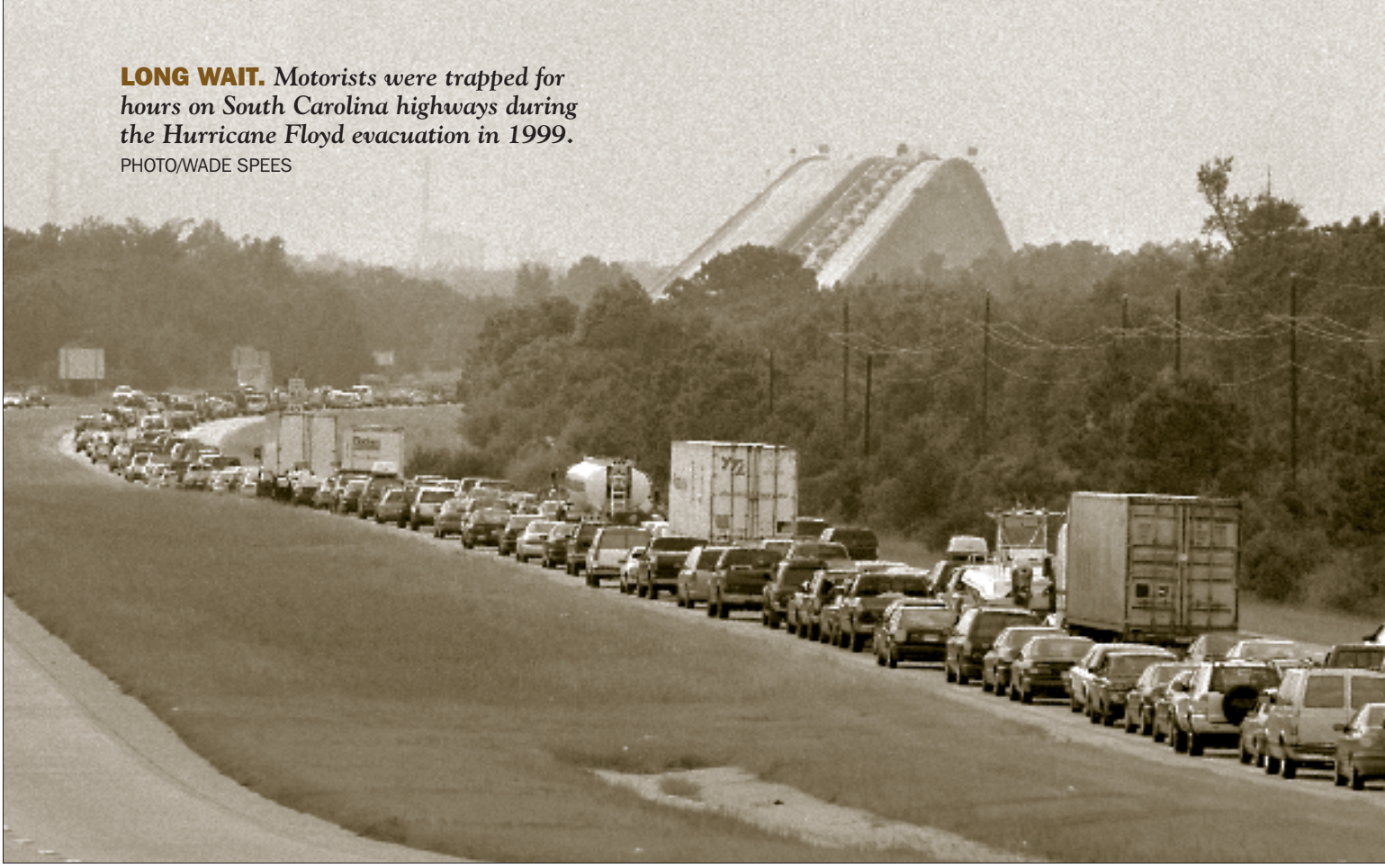
SHRIMP SUMMIT. ***South Carolina shrimpers observe how cold-water shrimp, including spot prawns and pink shrimp, are caught in Alaskan waters.***
PHOTO/S.C. SEA GRANT EXTENSION PROGRAM

South Carolina's seafood industry could take heart from the growing "food movement" in the United States. More Americans are seeking out food from sustainable, local, organic, or small-business producers.

The author Michael Pollan has noted the success of five thousand farmers' markets around the country where consumers go to learn about food and those who produce it, but also to connect to a broader social network or community.

"Someone buying food [from a farmer's market] may be acting not just as a consumer but also as a neighbor, a citizen, a parent, a cook." The food movement, Pollan writes, "seeks to put the relationship between consumers and producers on a new, more neighborly footing, enriching the kinds of information exchanged in the transaction, and encouraging us to regard our food dollars as 'votes' for a different kind of [food production]."

For much of the past 30 years, two important producers—commercial fishermen and aquaculturists—of lowcountry seafood have been at odds. But in recent years they have starting working together, realizing that they face a common challenge from inexpensive imports. Now they see that the future of South Carolina's seafood industry could depend on whether it can convince consumers to "vote" for lowcountry products whenever they buy.



LONG WAIT. *Motorists were trapped for hours on South Carolina highways during the Hurricane Floyd evacuation in 1999.*
PHOTO/WADE SPEES

Get Started on Your Own Disaster Readiness

Since Charles Town was founded in 1670, hurricanes have killed thousands of South Carolinians, destroyed countless buildings, devastated businesses and industries, and wiped entire communities off the map. Catastrophic hurricanes were commemorated in family stories, in ballads passed down through generations, and sometimes even in formal ceremonies. During the month of August 1967, in prayer meetings and night vigils, the Gullah people of the Combahee River area recalled the hurricane of 1893, which killed at least 2,000 people.

Before the Civil War, a series of large tropical cyclones battered the lowcountry, causing massive destruction to rice plantations. In the decades following the war, storms destroyed so many rice dikes that planters could not afford to rebuild. The final blow to rice production in South Carolina was the hurricane of 1893, the second most deadly natural disaster in U.S. history.


Coastal Heritage
The Greatest Storm On Earth

1987. How you can protect yourself from hurricane winds and water.

Yet how quickly we can forget. After Hurricane Gracie hit South Carolina in 1959, four decades passed before the state was struck by another major hurricane: Hugo. By then, newcomers and old-timers alike had scant experience with tropical cyclones, and the lowcountry had lost many lessons in how and where to build safely on a hurricane-prone coast.

Hugo caused $7 billion (in 2007 dollars) in insured losses on the U.S. mainland, a record at the time for hurricane damage. Still, most of Hugo's insured losses were caused by relatively minor damages to large numbers of structures, according to Sea Grant researcher Peter Sparks, then a civil engineer at Clemson University. High winds ripped off roofing materials, and heavy rain poured into holes and gaps, soaking drywall and ruining furnishings and other valuables. One small hole in one roof can cause thousands of dollars in property losses.

After Hugo, there were calls for the establishment of tougher building codes

1993. Hurricanes Hugo and Andrew exposed cracks in the nation's emergency management.

and improved enforcement that would reduce losses next time. But code reform stalled perhaps because Hugo was widely regarded as an extremely rare event.

That perception changed when Hurricane Andrew struck Florida and Louisiana in 1992. Andrew totally destroyed 63,000 homes and partly damaged another 110,000, leaving 250,000 people homeless and costing $23 billion (in 2007 dollars) in insured losses.

Most of Andrew's property damage, like Hugo's, was caused by powerful winds that tore off roofing materials and broke windows. Rain poured inside structures and soaked valuable items.

Engineering surveys in South Florida showed that sloppy construction practices and poor enforcement of existing building codes caused many roofs to fail. Contractors did not tightly attach roofing tiles or shingles to plywood roofing sheets. In turn, plywood sheets were not thoroughly connected to rafters. Roof gables often weren't strapped to walls so the gables were pulled off by high winds. Sea Grant researchers had documented similar problems during engineering surveys in South Carolina following Hugo.

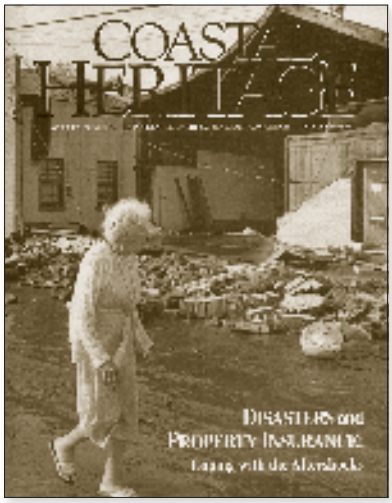
By the mid-1990s, coastal states faced a crisis in hurricane insurance. Rates and deductibles were rising rapidly, and insurers were increasingly excluding wind coverage from policies.

In response, by the end of the '90s, several southeastern states, including South Carolina, established new statewide building codes or improved their existing codes. South Carolina also required each locality to create a comprehensive plan, which provides opportunities to limit building in high-risk areas such as floodplains and beachfronts.

"South Carolina [was] ahead of the field compared to other southeastern states," said Tim Reinhold, a Sea Grant researcher formerly at Clemson University and now senior vice-president for research and chief engineer with the Institute for Business and Home Safety, a national insurance group based in Tampa, Florida. "With tougher standards and better enforcement, it's come a long way since Hugo." Reinhold and Sea Grant researcher Scott Schiff, a Clemson civil engineer, later delineated inexpensive methods of retrofitting houses to survive hurricane winds.

Despite the state's Hugo experience, South Carolina wasn't adequately prepared for its next hurricane challenge. In September 1999, a massive tropical cyclone named Floyd roared north from the Caribbean, raising fears that it could be the "Big One," a catastrophic modern storm that could kill thousands.

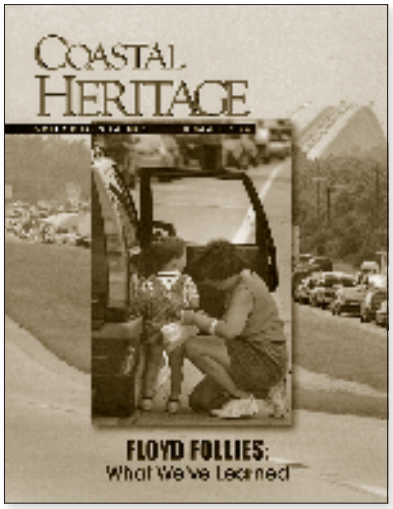
At least 3.5 million people from four states—Florida, Georgia, South Carolina, and North Carolina—evacuated from the coast during Hurricane Floyd. The largest evacuation in U.S. history turned into a four-state travel snarl.



1994-95. A growing number of coastal property owners couldn't find affordable wind-hazard insurance.

Cars were backed up for hundreds of miles on several interstates. Trips that would have taken two hours on a normal day took up to 18 hours. Many evacuees could not find bathrooms, motel rooms, or shelters. Cars ran out of gas or broke down, clogging highways and small roads.

After Floyd, hurricane planners in several states reconsidered how to expedite evacuations of millions of people out of harm's way. South Carolina emergency planners established new lane-reversal strategies on some major highways, expanded traffic-monitoring tools, disseminated public-information materials on evacuation routes, collaborated on multi-state evacuation planning, and several other measures.



2002. After Hurricane Floyd triggered an evacuation fiasco in four states, hazard managers searched for remedies.

Still, too many people try to squeeze onto too few roads. Each year, thousands of new residents migrate to the South Carolina coast, but the state's highway system isn't expanding quickly enough to keep pace.

The number of vehicles on the road during evacuations has also grown, even faster than the coastal population. As Hurricane Floyd approached, about 25 percent of households from the Charleston area evacuated in more than one vehicle.

"One of the reasons that the roads were so clogged was because people were

BEYOND PRESERVATION. *"My poor city," said New Orleans native and preservationist Stephanie Bruno, shown inspecting a house that Hurricane Katrina pushed 12 feet off its foundation.* PHOTO/WADE SPEES

taking more than one car," said Susan L. Cutter, a geographer at the University of South Carolina who studies natural disasters. Many families also hauled boats or recreational vehicles, adding to congestion. "People were evacuating as a household unit, but they were traveling in separate cars and communicating by cell phone, doing it in a caravan."

When Katrina struck the Gulf Coast, it spawned a 28-foot storm surge, the highest in U.S. history, but many thousands evacuated and escaped danger. By all accounts, evacuations in advance of Katrina were orderly and effective. Nevertheless, far too many people remained behind in dangerously flood-prone areas. At least 1,836 people lost their lives as Katrina swept ashore and in the subsequent floods as the hurricane roared inland.

Katrina, moreover, left tens of thousands of people homeless. Many homeowners were uninsured for floods and couldn't afford to rebuild. Entire neighborhood blocks on the Gulf Coast were littered with gutted houses or empty lots where houses once stood.

Hazard insurance can be complicated and rife with loopholes. But homeowners can protect themselves from catastrophic financial losses by understanding one important principle.

That is, when water rises from below—from a storm surge, a river flood, or a broken levee—a standard homeowners policy, which covers high-wind damage, will not pay out. Only federal flood insurance covers rising water. The Federal Emergency Management Agency manages this supplementary insurance through the National Flood Insurance Program but homeowners typically buy policies from private insurance companies.

During the early 1970s most coastal localities in the United States began joining the flood-insurance program. Within member communities, it requires that any new or substantially remodeled flood-prone structures must be elevated high enough to escape rising water.

That's why many beachfront and marshfront homes built after the mid-1970s are raised on tall pilings or foundations. Over the past two decades, many building-code departments have beefed up enforcement of elevation requirements during the permitting process. The reality is that if you want to acquire a mortgage on a home in a government-designated floodplain, you have to buy flood insurance.

But many thousands of homes still fall between the cracks. Along the Gulf Coast, some Katrina victims knew they lived in flood-hazard zones but had not bought flood-insurance policies on their homes. Other victims purchased flood policies but let them lapse. Still others believed that because they lived outside of official flood-hazard zones that they would never get flooded.

These problems are not limited to the Gulf Coast. They can be found in virtually every hurricane-prone region, including the South Carolina lowcountry.

But New Orleans was a special case in one respect. In low-elevation neighborhoods of New Orleans, lenders had told mortgagees that levees built and maintained by the U.S. Army Corps of Engineers would provide complete protection from flooding and, therefore, homeowners didn't need flood insurance. When their homes were swamped, thousands of New Orleans residents lost everything they owned, and many lost their lives.

Katrina and later major hurricanes also re-exposed the coastal wind-insurance crisis. To protect themselves from catastrophic financial losses, primary insurance companies such as State Farm and Allstate purchase policies from global

financial companies called reinsurers.

The global reinsurance market is unregulated, and reinsurance prices can rise and fall dramatically from year to year. The hurricane season of 2005, which included Katrina and Rita, proved that hugely expensive U.S. disasters place intense pressure on the global reinsurance system.

In 2006, global reinsurers recalculated their vulnerabilities to U.S. hurricanes, and they raised premiums by as much as 300% for primary insurers that sell homeowner policies in coastal South Carolina.

As a result, primary insurers once again limited their own exposure to financial risk, and many lowcountry residents had to scramble to find affordable policies—a problem that continues along the coast today.

In 18 states along the U.S. Gulf and Atlantic seaboard, most major insurers retreated after Katrina, selling fewer policies or not renewing them. Companies ratcheted up premiums and deductibles for coastal homeowners, narrowed terms of deductibles, or turned away new customers.

Hurricanes over the past 20 years have provided painful lessons. Preparing for, responding to, and recovering from major disasters requires cooperation among all sectors of society.

2006. Why do so many coastal property owners fail to purchase flood insurance?

Today hazard managers emphasize a comprehensive strategy of "disaster resilience" for communities, businesses, individuals, and families. Reforms and new measures include:

- establishing new or improved building codes and comprehensive plans to manage development in hazardous places;
- educating the public to prepare their homes for high winds and floods, to purchase hazard insurance, including flood insurance, and to receive and act on disaster warnings;
- improving the strength of new and existing public buildings such as schools, shelters, police and fire stations, and emergency facilities;
- protecting wetlands, forests, and other natural places along waterways that provide flood protection;
- limiting shoreline protections—levees, bulkheads, revetments, and seawalls—that cause localized erosion along coastlines;
- identifying flood-prone areas, improving storm-drainage systems, enacting special building standards and setbacks for flood hazards, and other flood-management tools;
- creating post-disaster plans that help localities identify disaster-prone areas and choose appropriate locations to rebuild after a storm; and
- improving communications among various government agencies at all levels, businesses, and nonprofit organizations for disaster planning, response, and recovery.

Thirty years ago, residents of the U.S. southeastern coast were complacent about hurricanes. And even after Hugo and Andrew struck in 1989 and 1992, respectively, local and state officials could have immediately pressed for building-code reforms that would have made homes and businesses more wind-resistant.

Instead, while population and development boomed along shorelines, many communities continued to ignore the hurricane threat. Very few localities, in fact, tightened building codes and boosted enforcement. Dozens of major metropolitan areas failed to establish adequate evacuation routes and safe public shelters. Planning and preparing for hurricanes and other natural disasters were apparently not at the top of government's priority list.

But over the past decade as more storms hit U.S. shorelines, many coastal states and localities finally pushed through reform measures. Governments toughened building codes and enforcement to make new homes and other structures more hurricane-resistant; tightened enforcement of flood-insurance requirements for new and substantially remodeled structures; and improved evacuation planning to move large coastal populations out of harm's way.

2009. Government can help us during emergencies, but citizens and businesses must be better prepared for disasters.

Even so, South Carolina will continue facing growing population and development pressures. It will become increasingly difficult, for example, to evacuate everyone who wants to leave the coast as a hurricane approaches. For coastal homeowners, it will become harder to acquire and keep wind-hazard policies purchased from private insurers; and over time those policies will become even more expensive, particularly following major hurricanes.

The reality is that government alone can't solve every problem. Families, individuals, and businesses must become more involved in their own disaster readiness. Long-time residents need to keep memories and lessons of past storms alive and educate newcomers about what it's like to be poorly prepared and experience a major hurricane.

GREEN TECHNOLOGY. *Tom Gion, a laboratory technician at Southeast BioDiesel in North Charleston, drew a sample for a quality-control test. Processed from poultry fat, this fuel in a diesel engine can reduce a vehicle's carbon emissions up to 78%, the company said.* PHOTO/WADE SPEES

Is the Coast Prepared for Climate Change?

How will South Carolina's coast experience climate change? It will hit us hardest during giant storms, scientists say. Higher storm surges will batter coastal homes, businesses, and infrastructure with higher waves, destroying property and threatening lives.

"You have the long-term trend of rising sea level, and then you put storms on top of it," said Eileen Shea, director of the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center in Asheville, North Carolina. "It's the combination of sea-level rise and storm surge that will most affect coastal communities."

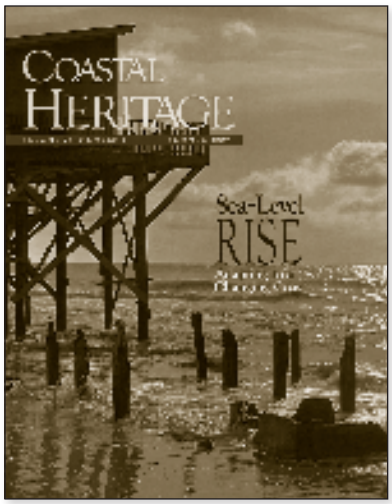
Rapidly growing amounts of carbon dioxide (CO_2) and other greenhouse gases are pouring into the atmosphere from smokestacks, tailpipes, and other sources, trapping heat and driving up the temperature of the Earth. Today, atmospheric CO_2 is greater than it's been during the past 800,000 years.

From 1750, at the beginning of the Industrial Revolution, the atmospheric concentration of CO_2 was 280 parts per million (ppm). Now, it's nearly 390 ppm.

The Earth is warming most rapidly at higher latitudes, particularly at the poles. Huge volumes of water are pouring into oceans from land-based polar ice, most crucially from the ice sheets of Greenland and Antarctica. Ice-sheet losses are driving up global sea level, and glaciologists say this process will accelerate.

Scientists estimate that global sea level will probably rise about one meter (almost three feet) and perhaps even two meters (almost seven feet) by 2100. On coastlines around the world, including South Carolina's, the results will be increasing salt-marsh losses, beach erosion, saltwater intrusion of water supplies, and greater flooding of towns and cities.

"In many locations, we have time to figure out how to adapt to sea-level rise," said Jessica Whitehead, regional coastal climate specialist with the South



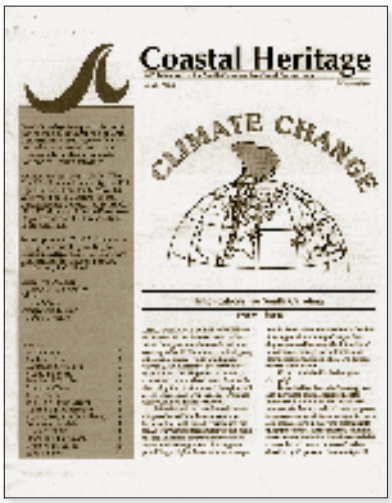
2009. How will South Carolina adapt to rising sea level?

Carolina and North Carolina Sea Grant Extension programs. "But major storms can change a coastline rapidly. Shoreline change can move slowly, over half a century, or it can hit you in a blink of an eye."

In four major assessments by the Intergovernmental Panel on Climate Change (IPCC) published over a 17-year period, scientists have issued warnings about climate change and its current or future impacts. Each new assessment, summarizing thousands of peer-reviewed studies, has provided an increasingly grim snapshot of climate change.

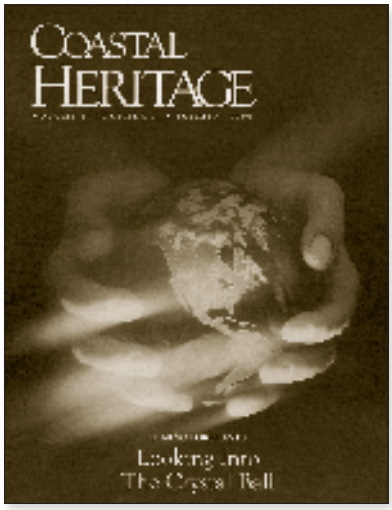
In 1990, the IPCC reported that greenhouse-gas emissions resulting from human activities were substantially increasing atmospheric concentrations of greenhouse gases, which would increase average temperatures of the Earth's surface.

More than 20 years ago, the S.C. Sea Grant Consortium convened a conference in Columbia on climate change and published its proceedings. Speakers and a concurrent issue of *Coastal Heritage* focused on major causes of global warming, computer-model forecasts of climate change, and potential impacts on South Carolina. "There is virtual consensus among climatologists that global warming will increase due to man's activities," reported *Coastal Heritage*. "The real question is how great the warming will be."



1990. An exploration of climate change and its potential impacts in South Carolina 20 years ago.

The second IPCC assessment, in 1995, reported that climate change was not just a problem for future generations. Scientists had found a "discernible human influence" on contemporary climate. The IPCC also reported that greenhouse-gas emissions continued to rise.



1996. Can improved forecasting of climate changes protect human health and property?

Scientists, meanwhile, were puzzling over an unusually warm and persistent El Niño (1991-1995) that spawned weather extremes, including severe droughts and destructive floods, in regions around the world. Could El Niño, a periodic warming of the central Pacific, become more frequent or intense because of climate change, causing even greater weather-related disasters in the future? This question has yet to be answered.

The IPCC's third assessment, in 2001, was a turning point in scientific understanding of climate change. Scientists pointed out new and stronger evidence that most of the Earth's warming observed over the previous 50 years was attributable to human activities. That is, instead of identifying just a "discernable human influence" on recent climate, scientists had found that human society was probably the primary driving influence.

During the 1980s and 1990s, many Americans were identifying unusual changes in wildlife, ecosystems, and weather patterns in their own regions. Spring, for instance, seemed to be arriving earlier than it used to. Species were migrating at different times than before.

Scientists noticed it, too. Over several decades, hundreds of research projects examined a correlation between climate change and a biological response in plants or animals somewhere in the world. In 2002, two research teams, working independently, analyzed many of these previously published papers, offering a startling picture of a changing climate's impacts on wild creatures. The teams, reporting in *Science* and *Nature*, found that species were making significant temperature-related shifts in response to climate change. For instance, spring events—migrating, blooming, and nesting—had shifted earlier by an average of five days per decade over 30 years for temperate-zone species.

The IPCC, in 2007, issued its most urgent warning to date. The Earth's atmosphere is now on track to reach a CO_2 concentration of 450 parts per million (ppm) before mid-century under a business-as-usual scenario. As a result, the Earth would warm by at least 2° Celsius (3.6° Fahrenheit) or more above pre-industrial levels. Climate scientists agree that a global temperature increase on that scale would probably cause more extreme droughts, storms, and floods with dangerous effects on agriculture and water supplies.

Some leading climate scientists now agree that hurricanes will probably become more intense, though slightly less frequent, as the Earth warms later this century. This remains a topic of continuing discussion, however.

Who is most vulnerable to climate change along the South Carolina coast? It's people living in older homes in very low-elevation locations near coastal waters or salt marshes. A typical older home located along the coast has an occupied first floor less than 10 feet above mean high tide, and those residents could face life-threatening flooding during major storms.

Flood dangers in many lowcountry locations will increase because of a combination of rising sea level and salt-marsh losses. Studies on the Gulf Coast

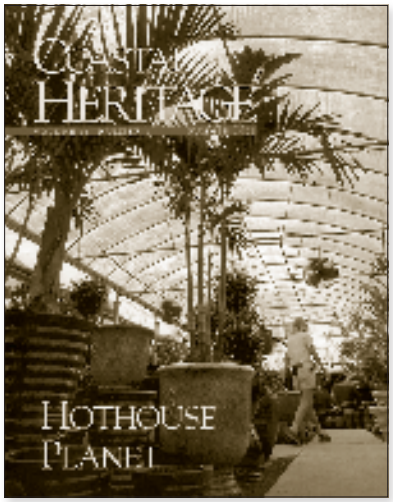
and elsewhere have shown that giant, healthy salt marshes provide crucial storm buffers during hurricanes.

But within 50 years, many low-elevation salt marshes in South Carolina will likely drown because of rising ocean levels, according to James T. Morris, a marine scientist and director of the University of South Carolina Belle W. Baruch Institute for Marine and Coastal Sciences.

Coastal wetlands will naturally tend to migrate landward, and many landowners will seek to protect their marshfront properties with bulkheads and other hard structures, thereby preventing this migration from occurring.

"The public seems most concerned about beachfront erosion," said Clay McCoy, coastal-processes specialist with the S.C. Sea Grant Extension Program. "But there also will be early and dramatic changes in low-elevation places behind barrier islands and along tidal creeks, where you'll see salt marshes and high water moving into people's backyards and businesses."

To slow the pace of climate change, governments must join with the scientific community and utilities to reduce carbon pollution, particularly in energy production, though this will be a difficult task.



2003. Which wild creatures can adapt to accelerating climate change?

Developing renewable energies is essential to building low-carbon economic growth. Fossil fuels such as coal and oil are high-carbon energy resources, while offshore wind energy, for instance, shows promise as a low-carbon one. (No-carbon energy sources don't yet exist. All energy sources today release carbon at some point during installation, operation, and repair.)

2007. Rising sea level is forcing some salt marshes to migrate inland, endangering coastal properties.

Five northeastern coastal states—from Delaware to Massachusetts—are poised to construct wind farms in the sea and recruit wind-power manufacturers in an effort to stimulate new, green industries and jobs. A Massachusetts project, Cape Wind, has already received a federal go-ahead, though it could be held up in court challenges.

"There's a growing realization in South Carolina," said Ralph Nichols, a Savannah River National Laboratory engineer, "that we have to do something with offshore wind, which is our main renewable energy resource for electricity generation."

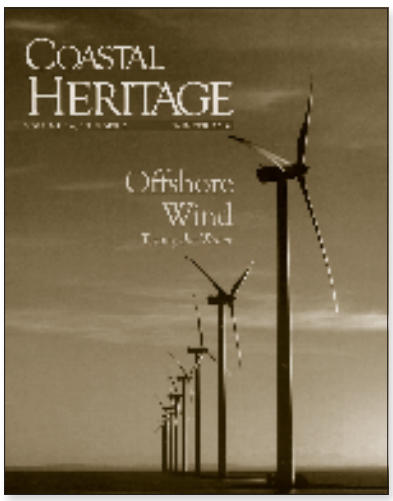
Atlantic coast states that are first to develop off-shore wind facilities will have better chances of attracting companies that manufacture, assemble, install, or service wind turbines, blades, cables, and wind-turbine foundations.

The Clemson University Restoration Institute and its partners have acquired $98 million in grant and matching funds to plan and operate a facility to test next-generation wind turbines and drivetrains at the institute's research campus on the former Navy base in North Charleston. It's expected to open in 2012.

"The states that are 'first in' would get the economic benefits" of developing a manufacturing base for wind power and technical skills of its workers, said Sea Grant researcher Paul Gayes, director of the Center for Marine and Wetland Studies at Coastal Carolina University.

Santee Cooper, the state-owned utility, Coastal Carolina University, the S.C. Energy Office, and the University of North Carolina–Chapel Hill have undertaken a venture called the Palmetto Wind Research Project to deploy buoys to document offshore winds along the northern stretch of the South Carolina coast. This area comprises a large portion of Santee Cooper's service area and has the state's strongest winds close to shore.

Weather buoys and land-based stations are measuring wind speed, direction, and frequency at stations up to six miles out into the ocean. One string of buoys is installed off Winyah Bay and another begins at Waites Island, near Little River. Sometime in 2010, Santee Cooper will also install an offshore platform near one of the buoy paths. For at least a year, instruments on the platform will measure upper-level winds similar to those a wind turbine would encounter.



2010. Can South Carolina establish effective incentives to develop offshore-wind power?

The S.C. General Assembly, moreover, appointed a Wind Energy Production Farms Feasibility Study Committee to examine offshore-wind energy. The committee, which released

its report on December 31, 2009, offered 18 recommendations to help the state prepare for development of wind-power generation and associated industries in South Carolina.

The committee recommendations include some of the following:

- South Carolina should establish clean-energy portfolio standards with targets for offshore wind and other renewable resources, energy efficiency, and nuclear energy;
- South Carolina should establish a leasing framework for offshore activities in state waters, a one-stop permit facilitation process for offshore projects, and wind-energy manufacturing incentives;
- a new wind-turbine test facility at the former Charleston Naval Base should become a focal point for an offshore wind industry in South Carolina; and
- the state should develop a "marine-spatial plan" for its offshore waters through the S.C. Department of Health and Environmental Control, allowing predictability in decision making and helping avoid conflicts with traditional ocean uses.

Developing renewable-energy resources will be crucial for South Carolina because climate change is not going away. Over the next 30 years, addressing climate change and energy scarcity will increasingly become a pressing concern to governments and households in all advanced countries and many developing ones.

Climate science is not new.

COST-BENEFIT. ***Offshore turbines are expensive to install and maintain, but they provide clean, low-carbon energy.***
PHOTO/YOBIDABA/DREAMSTIME.COM

Researchers have understood the basic science of climate change for 150 years. Indeed, the theory of the greenhouse effect is as old as the theory of evolution.

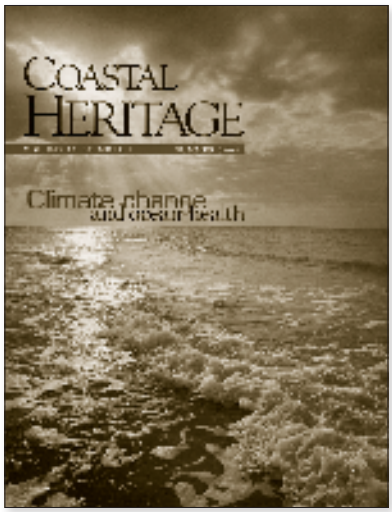
The past three decades have seen numerous breakthroughs in climate science. In 1981, James Hansen, who directs NASA's Goddard Institute for Space Studies, built a climate model calculating that the 1980s would be an unusually warm decade because of a buildup of greenhouse gases in the atmosphere. His model also predicted that the 1990s would be even warmer because of greenhouse warming. Both calculations proved accurate.

Climate scientists also have run computer models into the recent past to see whether simulations accurately reproduce events and temperatures that have already occurred. During the 1980s, global temperatures steadily rose. But in 1991, the volcano Mount Pinatubo in the Philippines erupted and sent huge quantities of sulfur dioxide into the atmosphere. The resulting sulfur haze, which reflected some solar radiation back into space, temporarily cooled the Earth's atmosphere by 0.5° C (0.9° F). The haze faded within months, and the global temperature climbed again. In 1992, Hansen ran a computer model that very closely simulated Pinatubo's effect of atmospheric cooling and subsequent warming.

Computer models of the Earth's atmosphere will never be perfect. But over the past three decades, scientists have refined, improved, and tested models and other tools to calculate and forecast climate change. Meanwhile, scientists have studied evidence from ice cores extending back 800,000 years. Ice cores allow scientists to estimate atmospheric CO_2 levels and temperature during past climates, revealing close linkages between greenhouse-gas levels and global warming or cooling at various times in the geologic record.

Scientists have also detailed records of temperature changes over the past 150 years and precise records of atmospheric CO_2 levels over the past 50 years.

Moreover, growing emissions of CO_2 have altered the ocean's chemical balance, scientists have discovered. As the ocean absorbs more CO_2 from the atmosphere, it turns acidic. The ocean is naturally slightly alkaline, but the ocean has become 30 percent more acidic since 1750.

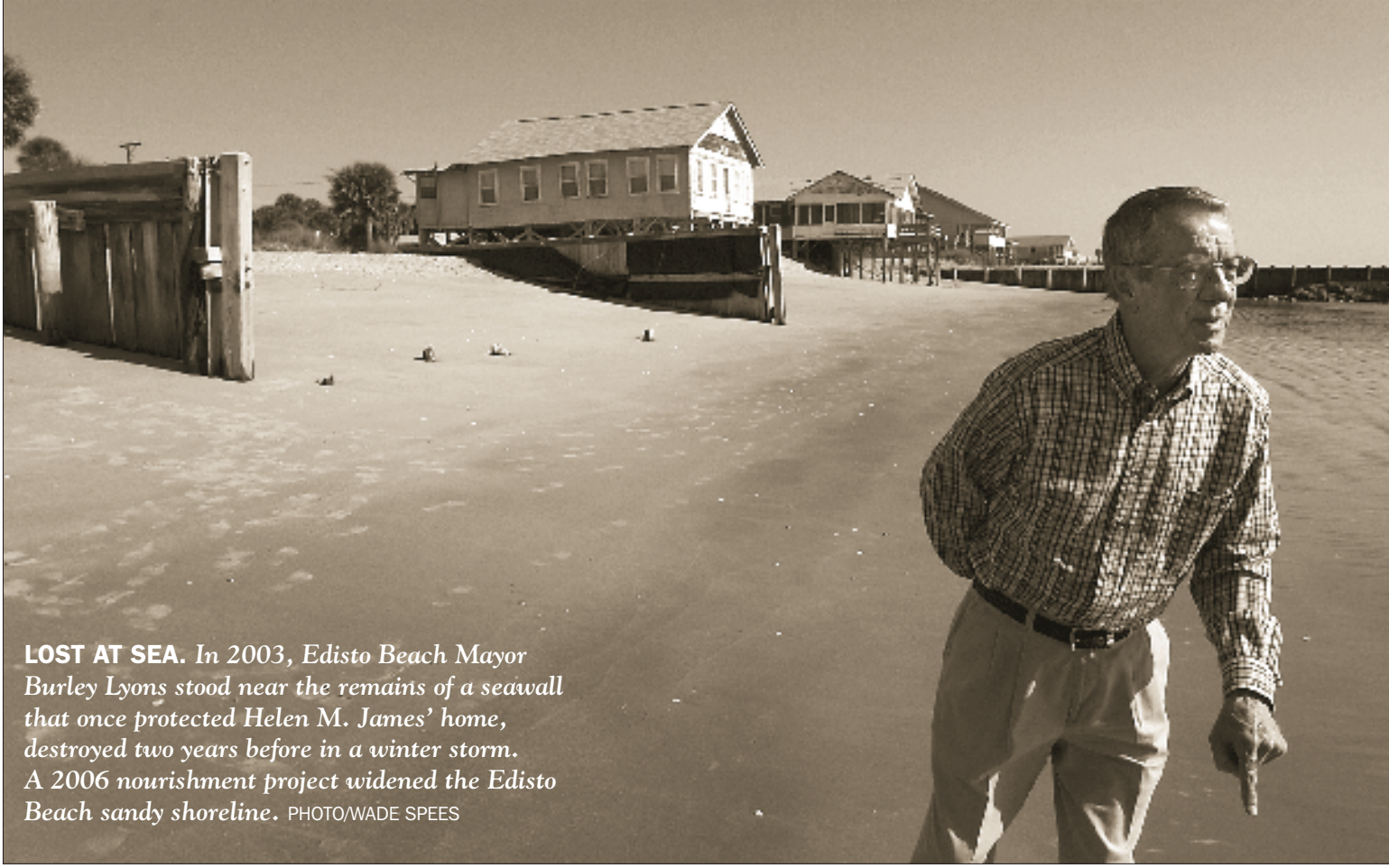


2008. Warmer, more acidic oceans threaten global fisheries.

By 2050, increasing ocean acidity is expected to disrupt the growth of marine creatures that build shells, including oysters, clams, lobsters, scallops, whelks, blue crabs, and many others. These animals could become smaller and malformed. Blue crabs in the Atlantic estuaries, for instance, would probably become runts by mid-century.

"Acidification would directly affect anything in the ocean that has a shell—about half of the total value of U.S. fisheries," said Scott Doney, a senior scientist with the Woods Hole Oceanographic Institution.

After 30 years of research and observation, the evidence is powerful and overwhelming. By sending growing amounts of carbon pollution into the atmosphere, modern civilization has embarked on an unintentional experiment of our planet's life-support systems. Now, we must begin deploying our ingenuity to develop an economy based on low-carbon energy resources while also adapting to disruptions spawned by this planetary experiment. How can the lowcountry rise to the challenge?



LOST AT SEA. *In 2003, Edisto Beach Mayor Burley Lyons stood near the remains of a seawall that once protected Helen M. James' home, destroyed two years before in a winter storm. A 2006 nourishment project widened the Edisto Beach sandy shoreline.* PHOTO/WADE SPEES

Challenges of Managing South Carolina's Shorelines

In 1983, some Folly Beach property owners battled shoreline erosion by dumping junkyard and construction materials on the oceanfront, reported *Coastal Heritage*.

In the freestyle manner of that time and place, they cobbled together improvised seawalls from "whatever materials—boards, bricks, blocks, bed frames—they could lay their hands on."

One determined property owner poured a slab of cement from his restaurant patio across the beachfront in an effort to stop erosion. He said he would buttress the slab with "broken bricks and pieces of concrete, salvage material that he can pick up from construction sites," reported *Coastal Heritage*. He planned to add more bricks and pour more cement until the shoreline was fixed in place and seawater would no longer flood his property.

What he apparently didn't realize is that seawalls—improvised or not—allow waves to scour away beach sand even faster than before. As a result, the beachfront drowns, disappearing under water, leaving behind the armoring of cement, rocks, or other materials. Visitors and residents, then, lose access to the shoreline.


Coastal Heritage

The Beach That Was

ATLANTIC OCEAN

1983. Why South Carolina needed state policies to protect its beaches.

State leaders were already debating how to balance the public's right to enjoy the beachfront against the need of private landowners to protect their property. The S.C. Sea Grant Consortium organized a conference in 1983 about managing South Carolina's migrating beaches. Scientists warned that sea level would continue to rise in many locations and that beachfronts would further migrate landward. The state's valuable beach-tourism industry was at risk if property owners continued to armor shorelines and drown sandy beaches.

In 1988, South Carolina became one of the first states in the nation to protect its beaches with an orderly retreat from the sea when its General Assembly passed the Beachfront Management Act.

SANDBAGGED. ***In 1997, Dick Johnson explained why he and fellow property owners were seeking permits to install giant sandbags to protect their Isle of Palms homes. Almost once every decade, a stretch of Isle of Palms beachfront erodes abruptly, threatening homes. There are several similar "hotspots" of erosion along the South Carolina coast.*** PHOTO/WADE SPEES

Soon after the law was enacted, however, it was challenged in court.

In 1986, developer David H. Lucas had purchased two undeveloped oceanfront lots on the Isle of Palms for $975,000. After the 1988 law was passed, Lucas realized that his lots were located in a new, so-called "dead zone" jurisdiction—that is, a no-construction zone. Because Lucas was prohibited from building on his lots, he argued that the 1988 law had illegally "taken" his shorefront lots. The state of South Carolina had rendered his property worthless, he said.

Lucas pointed to the Takings Clause of the Fifth Amendment, which says, "[N]or shall private property be taken for public use without just compensation." Lucas took the state to court, demanding compensation for his losses. He won his case in the U.S. Supreme Court in 1992, and a year later received a settlement of $1.55 million from the state, including the transfer of the two disputed lots to the state, which later sold them.

Yet before *Lucas v. Coastal Council* was decided, the South Carolina legislature had already revised the law, eliminating the dead-zone restriction. That change made it possible for some property owners to develop oceanfront properties if they acquire special state permits.

Did the *Lucas* decision eviscerate South Carolina's capacity to retreat from the ocean? No. Two principles in the original 1988 act have remained linchpins in the state law. First, all new beachfront homes must be set back from the ocean. Second, and far more important, is the Beachfront Management Act's seawall provision, which also remains effective. Construction of new seawalls is prohibited, and today a seawall built before 1988 cannot be rebuilt if 50% or more of it has been destroyed in a storm.

In fact, the seawall provision is the crux of the state's policy of retreat. South Carolina would not have an effective retreat policy without it.

That's the view of the S.C. Shoreline Change Advisory Committee, comprising 23 experts from academia, government, and the private sector. The committee, convened by the S.C. Department of Environmental Control–Office of Ocean and Coastal Resource Management (SCDHEC–OCRM), recommends reforms of the state's shoreline management in an April 2010 report.

The committee acknowledges that the seawall provision is the only powerful lever in South Carolina's retreat policy. But this provision has never been fully tested in U.S. courts. Would it pass constitutional muster?

The U.S. Supreme Court, legal scholars say, someday could have to decide whether banning seawalls is a taking of private property without compensation or whether such measures are justified to prevent losses of public-trust shorelines.

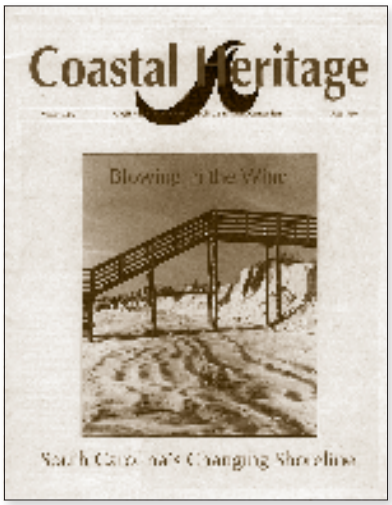
The American "public-trust doctrine" has roots in English common law. For centuries, English courts have backed citizens' rights to use waterways and shorelines for fishing and transportation, even when shorelines have been privately owned. Waterways, then, are held in public trust for all. This was especially important when rivers and coastal areas were the only reliable highways. The original 13 American states adopted the public-trust doctrine upon independence, as did the other 37 states when they entered the union. In the late 1980s, the U.S. Supreme Court affirmed that states could protect public-trust areas not only for navigation and fishing but also for recreation and other uses.

The S.C. Beachfront Management Act's seawall provision, then, preserves public-trust areas that would be lost if beaches were armored with seawalls. In South Carolina, the public owns coastal property from the ocean to the mean high-tide line—the location along the shoreline where the average high tide reaches twice a day.

After 1988, property owners could no longer build new seawalls or repair many old ones after storms. So, some beachfront communities turned to a different kind of engineering—beach "nourishment"—to hold back erosion and rising sea level.

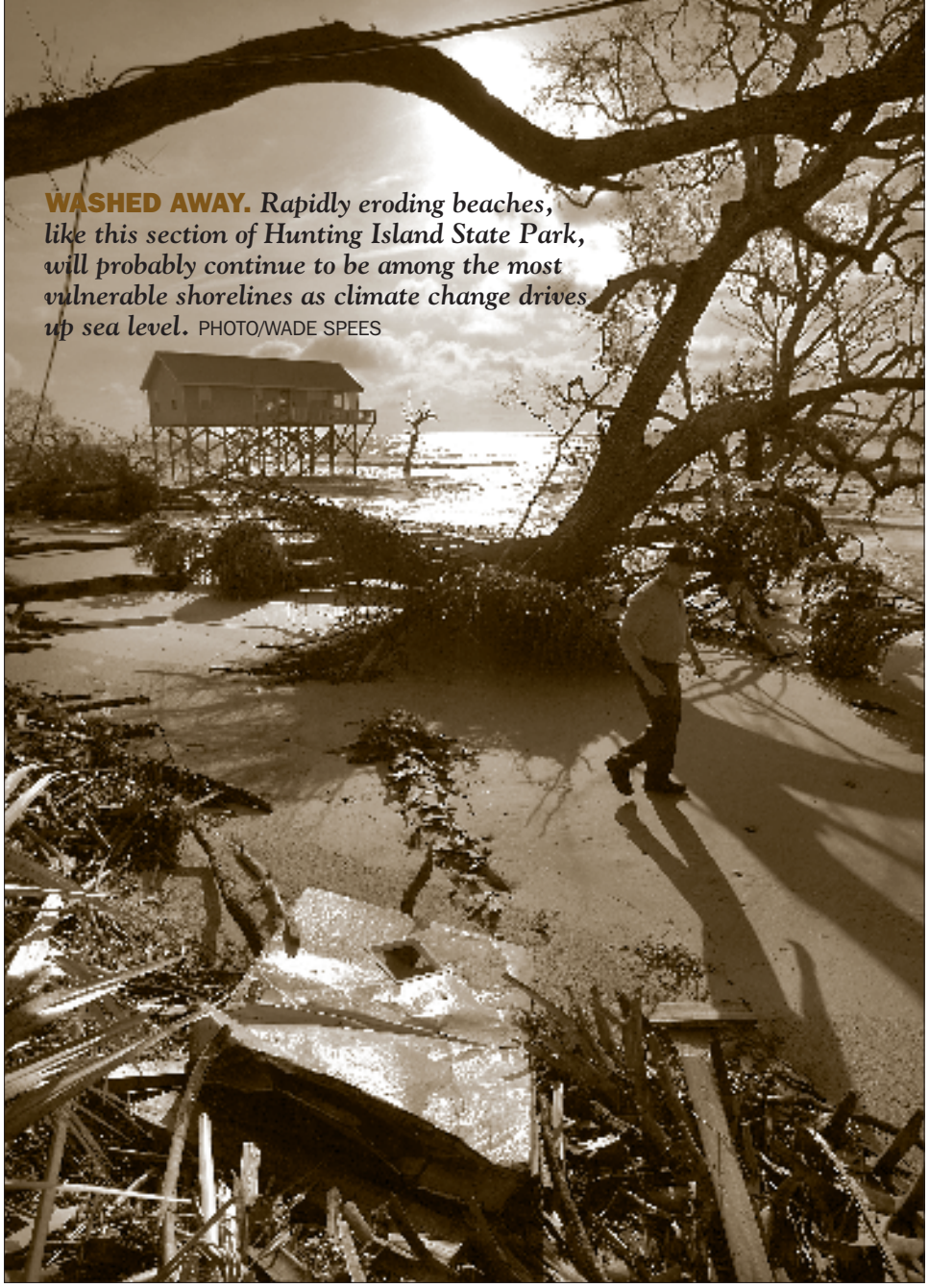
To nourish beaches, engineers at one time mined sand from inland pits and trucked it to the eroded beach to provide a buffer against erosion and storms.

Today, South Carolina nourishment projects dredge sand from offshore deposits or from nearby tidal shoals. In the mid-1980s, Sea Grant scientists Ben Sill and Earl Hayter, Clemson University engineers, delineated the size and location of many of South Carolina's tidal shoals, which are seaward and



1990. A debate raged over the costs and benefits of beach nourishment.

2003-04. Beach nourishment is a practical but temporary response to erosion.



WASHED AWAY. ***Rapidly eroding beaches, like this section of Hunting Island State Park, will probably continue to be among the most vulnerable shorelines as climate change drives up sea level.*** PHOTO/WADE SPEES

landward of most tidal inlets. Mining sand from tidal shoals, though, is controversial because it can damage wildlife habitat, interfere with shipping, and alter coastal processes.

Beach nourishment is "soft" engineering, unlike building "hard" structures such as dikes and seawalls, but it is engineering nevertheless.

Two decades ago, critics argued that beach nourishment would become too expensive and that most of the engineered shoreline would wash away in a short time. Yet many nourishment projects have lasted longer than critics expected. And there is strong evidence that nourishment has provided effective buffers during storm surges and extreme high tides, protecting some properties and coastal infrastructure.

"Our beach is doing well," said Mayor Burley Lyons of Edisto Beach. In 2006, a project to nourish Edisto Beach temporarily raised the shoreline there. "We hope it will last 10 years," said Lyons, "unless along comes another Mr. Hugo or one of those bad boys, and then we're in trouble."

For now, nourishment projects, usually funded in large part by federal and state taxpayers, are making new seawalls unnecessary along many eroding shorefronts. Dredging and pumping sand onto beaches from offshore deposits has temporarily raised and restored large stretches of South Carolina's oceanfront.

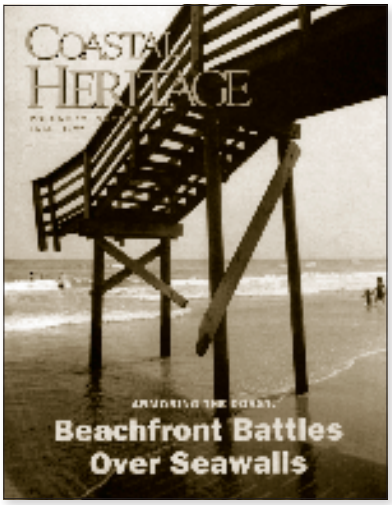
Scientists say that beach nourishment will probably become more expensive and difficult over time as communities search for additional sources of sediment to pump onto the beaches.

Some parts of the South Carolina coastal ocean are already "sand starved," said Sea Grant researcher Paul Gayes, director of the Center for Marine and Wetland Studies at Coastal Carolina University. Many regions lack significant offshore sediment resources for nourishment, and they will need to search elsewhere to mine sand.

In 1994, the S.C. Sea Grant Consortium, in partnership with and funding provided by the U.S. Geological Survey, initiated the South Carolina Coastal Erosion Study with a goal of establishing a "sand budget" for the coastline.

The project was conducted in two phases. The first, completed in 1999, focused on a surveillance of the mid-section of the South Carolina coastline. This initial work, which involved studies of offshore and nearshore geology, historical movement of the shoreline, and sediment volume and transport rates, provided useful information about the degree to which some South Carolina beaches are eroding and where potential nourishment deposits of sand are located.

The second phase of the study focused on the Grand Strand region of the coast, where a more intensive bathymetric mapping effort comple-



1997. How can South Carolina balance beach preservation with the rights of property owners?

mented studies of historical geology, shoreline change, and sediment movement.

"The biggest benefit of the Coastal Erosion Study is that now we can actually say how much a beach is eroding," said Bill Eiser, oceanographer with SCDHEC–OCRM, in 2000.

With an increasing coastal population, additional infrastructure, rising sea level, and more intense hurricanes and coastal storms, it will become increasingly important to learn which beachfronts are eroding most quickly.

Rising sea level will dramatically compound problems of erosion in South Carolina and other coastal regions. Scientists say that global sea level could rise at least three feet by 2100, driving shorelines much farther inland.

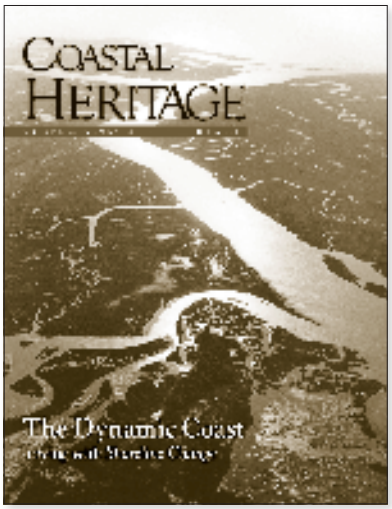
"We're seeing in Louisiana how barrier islands erode rapidly and disappear," said Abby Sallenger who runs the U.S. Geological Survey storm-impacts research group, which studies how extreme storms change coastal areas. "We can mine sand elsewhere and try to replace what's lost. But if that happens on a grand scale along the coast as sea level rises, we will have to decide as a society whether we want to spend tremendous levels of resources to do that."

An unintended consequence of beach nourishment is that new development is often attracted to these dynamic, hazardous places. The S.C. Beachfront Management Act allows the state's regulatory zone to be drawn farther seaward after publicly funded nourishment projects have widened shorelines. This redrawing has allowed some private landowners to build single-family homes or condominiums farther seaward than they could have done before the nourishment projects, even though additional pumping of sand would be required at taxpayers' expense to keep these beaches wide and stable.

The S.C. Shoreline Change Advisory Committee report recommends legislative measures that would prevent the state's regulatory zone from being redrawn seaward under any circumstances.

The committee also recommends permit conditions that would essentially require beachfront landowners to relinquish property rights to any added strips of beach seaward of the high-tide line at the time of nourishment. The state is establishing a Blue Ribbon Committee to evaluate policy needs related to shoreline management in South Carolina.

Nourishment is costly and will become even more so. How long will taxpayers be willing to pay for repeated pumping of sand onto beachfronts threatened by rising sea level?



2010. Finding tools to adapt to shoreline change.

Someday, nourishment projects and other "soft" engineering efforts will fail to keep up with sea-level rise, scientists say. It's a matter of time before many beachfront properties will have to be abandoned or armored with seawalls or other hard structures to protect property.

There's no question that erecting seawalls leads to drowning beaches. There's also no question that many property owners who are not allowed to build or rebuild seawalls will eventually lose valuable land to the sea. Someday it will require the wisdom of a King Solomon to find a remedy.

SERVING IT UP. ***Jennifer Salewski served dinner at the Starfish Grille. South Carolina's beach tourism supports businesses that employ tens of thousands of workers.***
PHOTO/WADE SPEES

DELUGE. *Walking across the Crosstown Expressway, a woman emptied her boot after heavy rain and a high tide flooded peninsular Charleston.*
PHOTO/ANDY PARAS/THE POST AND COURIER

Linking Sprawl and Water Quality

On summer days along the Grand Strand, small children play in the quiet, shallow tidal creeks locally called swashes that often spill over the beachfront and capture high tides. Kids and their mothers are drawn to swashes, which are more tranquil than the rough surf. Bacteria, unfortunately, contaminate the swashes.

Where do these bacteria come from? Rainfall picks up a nasty brew of pet and wildlife waste, sediment, pesticides, fertilizers, heavy metals, oil, and grease from paved surfaces such as roads, parking lots, and bridges. This contaminated stormwater, in turn, floods Grand Strand swashes, where it can stay for weeks.

Polluted swashes are just one example of stormwater runoff along parts of America's coastlines. Each year, elevated bacterial counts from stormwater runoff and other sources have caused potential health threats along beachfronts. The S.C. Department of Health and Environmental Control monitors water quality at 118 sampling sites along the state's coastline and issues public-health advisories when bacterial counts are elevated in the surf.

Three decades ago, regulators were focused almost exclusively on water pollution from so-called "point sources" such as factories and sewage treatment plants.

The first generation of water cleanup in the United States began with the Clean Water Act passed in 1972. Under this act, the U.S. Environmental Protection Agency (EPA), state regulators, and localities addressed contaminants in discharges from point sources. EPA continues to require that those dischargers apply for federal or state permits for contaminants they send into waterways. These efforts overall have been successful, experts say, in preventing or reducing contamination from factory outfalls and other point sources.

Yet many waterways remain polluted for drinking, swimming, and other uses. It was during the mid-1980s when a


Coastal Heritage

Flooding or Pollution?

1988. Scientists observe stormwater pollution as a major problem.

HOUSING BOOM. ***A giant new housing development in Dorchester County. To build conventional suburban tracts, developers cut down water-absorbing vegetation and install pavement and other impervious surfaces, increasing stormwater runoff.*** PHOTO/WADE SPEES

growing number of scientists observed that nonpoint-source or stormwater runoff had become a major environmental problem. In the late 1980s, the then S.C. Coastal Council established stormwater management guidelines, which provided best management practices for new developments.

Then, in the early 1990s, federal regulators began to crack down. First, EPA required that larger cities and major construction projects apply for National Pollution Discharge Elimination System (NPDES) permits for the contaminated runoff they produce and establish plans to manage it.

Since 1999, some 3,500 smaller municipal and county governments also have had to abide by stormwater rules, although it wasn't until 2007 that many South Carolina localities were required to implement them.

"The rules affect almost every local government now," not just the larger cities, said Bruce K. Ferguson, director of the University of Georgia School of Environmental Design and a nationally recognized expert in stormwater management. "They have to pay attention to this issue."

Today, untreated stormwater is still considered the most immediate and significant threat to coastal water quality in the U.S. Southeast, according to Craig Hesterlee, an EPA watershed coordinator.

Consider that one quarter of a million acres in the United States is paved or repaved each year, and most projects use paving materials that are manufactured with high concentrations of relatively fine materials of various sizes. These impervious—or dense— paving surfaces lack the tiny spaces, or voids, where rainwater can enter and filter through to the ground below.

When it rains in a meadow or forest, some of the precipitation filters into the subsurface where soils and beneficial microbes cleanse it. Eventually the water gravitates into the aquifer, recharging deep groundwater, or it seeps slowly downslope to recharge rivers, lakes, tidal creeks, and the ocean. Another portion of the rainfall is absorbed by plants and transpired back into the atmosphere. And some runs off the landscape, though slowly and steadily in most cases, into waterways.

Typical suburban or resort development, by contrast, transforms this water cycle. Conventional developers cut down water-absorbing trees and other vegetation, compact soils with heavy equipment, and install acres and acres of impervious surfaces.

During a one-inch rainfall, the volume of water coming off an acre of

2008. Scientists point to stormwater runoff as a major environmental problem.

impervious surface is 10 to 20 times greater than that from an acre of grass, according to a number of scientific studies. Adding impervious surfaces to just one-tenth to one-fourth of a natural watershed's acreage can impair local streams and creeks, perhaps permanently. Stormwater also moves more rapidly across impervious surfaces than across those of natural areas.

"As more and more people move into the coastal region, we are changing its water quality," said Geoff Scott, director of the NOAA–National Ocean Service Center for Coastal Environmental Health and Biomolecular Research in Charleston.

Just 40 years ago, the lowcountry was overwhelmingly rural with coherent small towns and cities. From 1970 to 2000, the lowcountry developed faster than any other region in the state, according to Mike MacFarlane, a demographer with the S.C. State Budget and Control Board. The 2010 census will show further growth in the region, and most of it has been conventional sprawling development, experts say.

Americans, moreover, have increasingly purchased second homes, retirement homes, and vacation condominiums along the banks of the nation's lakes, streams, rivers, and estuaries. New housing and tourism developments, which cover landscapes with impervious surfaces and close-cropped lawns, are often built as close to the waterways as possible, taking down healthy buffering natural vegetation that disrupts high-value views.

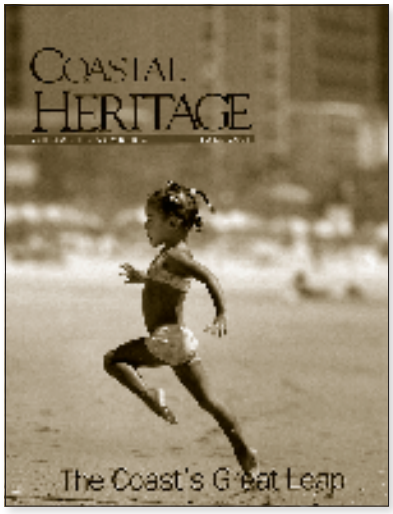
As homes along the immediate coast become more expensive, people are increasingly moving farther up watersheds into freshwater areas.

"Development is following water frontage in almost every watershed," said Cal Sawyer, formerly a water-quality specialist with the S.C. Sea Grant Extension Program and now associate director of Clemson University's Center for Watershed Excellence.

2000. Some experts say that sprawl should be stopped, but the public isn't going along.

During the boom of the 1980s and early '90s, lawmakers heard voter concerns about unplanned or poorly planned development. At that time many smaller communities did not zone or plan land uses, placing few restrictions on development that could harm water quality. In 1994 the S.C. General Assembly passed a law effectively requiring all local governments to establish comprehensive plans by May 3, 1999.

This law began a new era in local government in South Carolina. For the first time, most localities had to consider how and where to grow. Two counties—Beaufort and Charleston—took innovative steps to manage development in rural areas. They established comprehensive plans that allow and, in some cases, encourage measures to protect forests and open space, which can help soak up

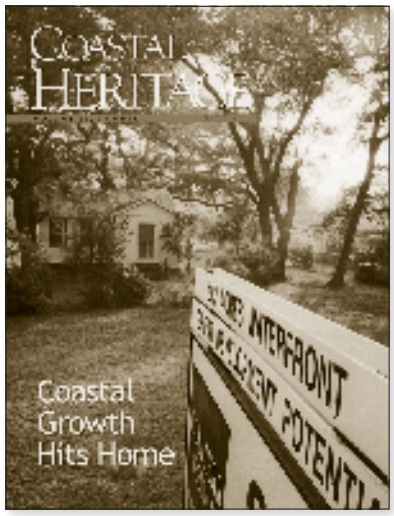


2004. South Carolina's coastal communities grow at a white-hot pace.

stormwater pollution. Under flexible ordinances allowed by the 1994 state law, developers could be required to build new projects with water quality in mind.

In 1998, Sawyer coordinated the Nonpoint Education for Municipal Officials program in South Carolina (SCNEMO). It was an effort to help local officials understand how various land-use management tools can reduce paved and hardened surfaces. Through free seminars, elected and appointed officials learned techniques to address impacts of land use on water quality.

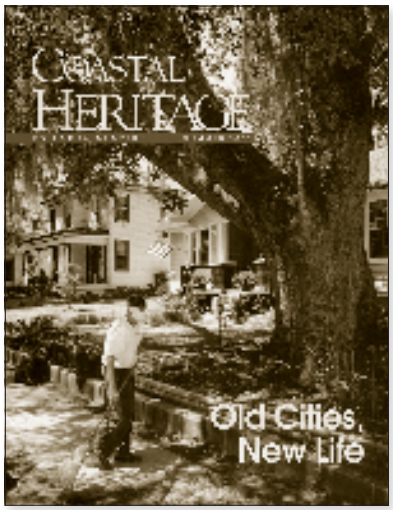
April Turner, coastal communities specialist with the S.C. Sea Grant Extension Program, continues to create educational programs for local officials about water quality, innovative site



2001. Land-use regulations in two South Carolina counties spark fierce debate.

design, and other smart-growth principles.

EPA's stormwater rules for smaller localities are complex, and officials say it will take time to learn how to implement them. Already, though, the regulations are proving to be expensive, and there is scant federal or state money available to help communities. Localities must identify pollution sources, which won't be easy, and find cost-effective solutions.



2005. Innovative developments are drawing residents to older suburbs and formerly blighted areas.

Also now a number of local officials, environmentalists, developers, architects, engineers, and scientists are calling for innovative "green-infrastructure" practices that can improve water quality in new developments and redevelopments, while saving money for localities and property owners over the long term.

The idea is to absorb and treat stormwater on-site now rather than try to fix pollution and flooding problems later by building costly "gray infrastructure," including extensive pipes, storage systems, and water-treatment plants.

Developers, for instance, can significantly reduce the amount of impervious surfaces in new subdivisions by building narrower roads or installing gravel or structurally supported grass on driveways and parking lots.

Other low-impact development (LID) practices, which supplement or replace traditional ways of managing stormwater, include:

- planting and maintaining trees and plants as vegetative buffers along waterways, helping to absorb pollutants, filter runoff, recharge groundwater and stabilize banks;
- installing porous pavements that allow runoff to infiltrate into the subsoil where cleansing and groundwater recharge can occur;
- building bio-retention landscaping features, which use natural processes to filter pollutants, such as swales, rain gardens, and pocket parks;
- constructing stormwater wetlands, which might be dry or boggy at times but can fill with stormwater after rainfall and allow potential pollutants to be filtered;
- installing rain barrels and cisterns that save rainwater, and reorient gutter downspouts to send water onto lawns instead of pavement;
- installing green roofs, which allow soil and plant materials there to reduce overall runoff; and
- concentrating homes in a compact portion of the development site in order to provide permanently protected open space and natural areas elsewhere on-site to filter rainfall.

"There haven't been a lot of low-impact development projects in South Carolina yet," says Sea Grant researcher Daniel Hitchcock, a biosystems engineer at Clemson University. "This is new here, but I think developers and engineers are catching on."

Currently, two communities in coastal South Carolina—a new green neighborhood called Oak Terrace Preserve in North Charleston and the rapidly growing town of Bluffton in Beaufort County—have installed low-impact technologies that capture rainfall and treat it by filtration on-site, as close to where it falls on the ground as possible. In this way, rainfall is filtered before it ever reaches detention ponds or waterways. The Oak Terrace Preserve neighborhood is part of a 20-year rehabilitation effort across North Charleston's oldest neighborhoods.

After a two-year study of LID strategies at Oak Terrace Preserve, Sea Grant researchers Dwayne Porter and Lisa Vandiver, of the University of South Carolina Department of Environmental Health Sciences, collaborated with Turner and others to publish several educational publications. For example, they created an LID maintenance manual, which provides guidance to homeowners associations such as inspecting and maintaining bioretention swales, pervious alleys and walkways, and pocket parks. Most homeowners associations are responsible for maintaining these systems.

Turner and her colleagues have also helped lowcountry communities consider the costs and benefits of establishing new stormwater-management programs, which can include stormwater utilities, supporting ordinances, and best management practices to protect local waterways.

Thirty years ago, there was little understanding of the impacts of stormwater and development on water quality. Today, however, numerous lowcountry communities are taking part in the nation's second generation of water cleanup, and there is a growing understanding among some local officials, developers, and property owners that water quality is closely tied to where and how we build homes, roads, and businesses. In the future, the challenge will be to educate the public about effective, inexpensive ways that citizens and communities can prevent pollution of lowcountry waterways, one of the region's most valuable natural resources.

2005-06. Green design and construction has arrived on South Carolina campuses.

The Next 30 Years...

Through the 1960s and '70s, most of the South Carolina coast was a quiet, dozing backwater with a reputation for gentle manners and insularity, a region bedazzled by its past. But, over the last few decades, the coast experienced its most sweeping changes since the end of the Civil War. For the first time in generations, the coast began asserting its place in national and international arenas.

Charleston's port embraced innovation, stimulating state and regional economies. A new generation of civic and business leaders pushed for major investments in schools, roads, streetscapes, bridges, parks, and waterfronts, plus many other public services and amenities.

The tourism and retirement industry expanded at a blistering rate, drawing a flood of new residents and visitors from around the world. South Carolina's colleges and universities established top-flight research and education programs. Lively urban centers attracted artists and entrepreneurs. A vibrant nonprofit sector found its voice on environmental issues and other pressing concerns. The coast has learned how to be more nimble in a fast-moving world.

Now, the stage is set for another three decades of economic and population growth. The lowcountry is becoming a center of innovation in green construction and development, renewable energy, aviation, health care, and the arts. The South Carolina coast will continue to attract investment and newcomers "from off."

But the region that once refused to change has now changed too much, some say.

Many quiet villages and traditional settlements have been transformed into look-alike "boomburgs," a term coined to describe explosively growing suburbs. Auto-dependent, sprawling growth threatens the region's water and air quality, open space, and historic uniqueness.

Meanwhile, climate change is driving up sea level, which in combination with large storms, threatens to swamp South Carolina's beachfronts, salt marshes, and other low-elevation areas.

These problems aren't going away.

Over the next 30 years, climate and weather challenges, sprawling growth, and escalating energy costs will probably be among the biggest stories on the coast.

The South Carolina coast will have to address more frequent, intense floods and their impacts on property owners and public infrastructure. Hurricane threats will continue to pressure evacuation systems for a growing coastal population.

Fuel for electricity and transportation, meanwhile, will become more expensive over the next 30 years. Demand is rising in the United States and around the world, and regulatory pressure to address climate change is increasing in many countries. Because of the Deepwater Horizon oil spill in the Gulf of Mexico, Americans have already become more aware of the costs—economic, social, and environmental—of extracting and burning fossil fuels.

Rising energy prices might change how many Americans live and work. Will more coastal residents live in smaller, energy-efficient homes in walkable "new-urbanist" or "smart-growth" neighborhoods with access to mass transit? Or will the lowcountry continue to build more sprawling, auto-dependent development?

Coastal communities are already deploying land-use planning and other tools in an effort to contain sprawl through regulations on new development, incentives to guide development patterns, and preservation of open lands. But voters will continue to debate government's appropriate role in guiding growth.

It seems likely that many future housing developments will imitate those of today. Developers know that in good economic times there is a strong housing market for families looking for sizable houses with yards on the suburban fringes. Prosperous retirees will continue seeking homes along waterways or salt marshes in the exurbs not too far from city amenities. Localities will build new roads and other infrastructure to accommodate developments. Sprawl will likely continue until in some locations it bumps against protected areas.

Some newcomers will move into higher-density urban areas, seeking city experiences. But Witold Rybczynski, a professor of urbanism at the University of Pennsylvania, has said that it's unrealistic to hope for much greater densities in most American urban areas, because "it's not how we live."

The real solutions to spread-out growth, moreover, "are pretty tough: they either involve raising the cost of gas by a factor of two, or imposing restrictions on private property. And neither of these things is likely."

Rybczynksi has called for improved planning, returning suburbs to a nineteenth century ideal of a "much more… green, country environment."

So, an ecologically benign sprawl? Is it possible to build spread-out suburban communities—places of elegance, open space, fresh air, trees—that won't harm the environment?

Perhaps someday coastal residents will drive electric cars that do not emit carbon into the atmosphere. But the juice that will power new electric cars will be generated in part by burning coal, which of all fossil fuels produces the most carbon dioxide per unit of energy.

Today's energy source for transportation—burning gasoline in our cars and trucks—is a major contributor to greenhouse-gas emissions in the United States. But it's likely that a large portion of tomorrow's energy source for transpor-

tation—burning coal for electricity—would be an even greater contributor to emissions unless the United States takes extraordinarily rapid strides in developing alternative energies.

In the future, it will become increasingly difficult to ignore that the Earth is warming and will continue to warm. China is already undertaking crash programs to develop renewable-energy technologies and stem its reliance on fossil fuels. The United States would have to make similarly rapid adjustments if it hopes to keep up with this global competitor. American cities and states that are pioneers in stimulating new, green industries and jobs will be ahead of the game.

Today, scientists and entrepreneurs are working on more efficient ways of drawing electricity from wind, sun, waves, tides, household waste, cellulose, and other potential sources. China is building sophisticated transmission systems to move electricity from regions with renewable sources of energy to urban centers, and the United States is trying to play catch-up. Meanwhile, smaller, lighter batteries are storing electricity to power cars, trucks, and other machines.

Still, capturing energy from most renewable resources will remain expensive, and higher energy costs will be passed on to consumers.

A year before the giant oil spill in the Gulf, South Carolina leaders recognized that our coastal ocean could someday produce clean, renewable energy. The legislature established a committee of stakeholders to examine the feasibility of offshore wind power here. At the close of 2009, the committee issued a report with a series of recommendations that could enhance the state's capacity to draw on offshore wind energy (see pages 19-20).

A team of public and private partners enabled the Clemson University Restoration Institute to acquire $98 million in grant and matching funds to plan and operate a facility to test next-generation wind turbines and drivetrains at the institute's research campus on the former Navy base in North Charleston. Expected to open in 2012, the facility will help the lowcountry attract companies that manufacture, assemble, install, or service wind turbines, blades, cables, and wind-turbine foundations.

Over the next three decades, the coast will have to apply its nimbleness, innovation, and flexibility to meet extraordinary challenges of the new world that's already upon us.

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NEWS & NOTES

Request for nominations: 2010 S.C. Environmental Awareness Award

Nominations will be accepted through December 20, 2010 for the S.C. Environmental Awareness Award, which recognizes South Carolinians doing extraordinary work for the environment. The award acknowledges outstanding contributions made toward the protection, conservation, and improvement of South Carolina's natural resources.

Each year the public is invited to submit nominations that are then reviewed by an awards committee, which considers excellence in innovation, leadership, and accomplishments that influence positive changes.

Committee members represent the S.C. Sea Grant Consortium, S.C. Department of Natural Resources, S.C. Department of Health and Environmental Control, and S.C. Forestry Commission.

For more information, contact Susan Ferris Hill at (843) 953-2092 or susan.ferris.hill@scseagrant.org. To submit a nomination, please visit www.scseagrant.org/Content/?cid=8.

Past winners include:
2009 – Fred Holland, ecologist, Charleston
2008 – Benjamin Ziegler, attorney, Florence
2007 – Richard Porcher, Jr., botanist, Mt. Pleasant
2006 – Rick Huffman, S.C. Native Plant Society, Greenville
2004 – John L. Knott, Jr., Noisette Company, North Charleston
2003 – Burris Family, Cypress Bay Plantation Tree Farm, Beaufort
2002 – Jack Turner, director, Watershed Ecology Center, University of South Carolina
2001 – James D. Elliott, Jr., founder, South Carolina Center for Birds of Prey
2000 – Dave Hargett, conservationist, Greenville
1999 – Kenneth Strickland, environmentalist, Florence
1998 – Yancey A. McLeod, Jr., environmental educator, Eastover
1997 – Brad Wyche, president, Friends of the Reedy River, Greenville
1996 – Beaufort County Clean Water Task Force
1995 – Whitfield Gibbons, senior research ecologist, Savannah River Ecology Laboratory
1994 – Marion Burnside, chairman, S.C. Department of Natural Resources
1993 – Dana Beach, S.C. Coastal Conservation League
1992 – Rudy Mancke, S.C. Educational Television

Subscriptions are free upon request by contacting: Annette.Dunmeyer@scseagrant.org

ATTENTION SCHOOL TEACHERS! The S.C. Sea Grant Consortium has designed supplemental classroom resources for this and past issues of Coastal Heritage magazine. Coastal Heritage Curriculum Connection, written for both middle- and high-school students, is aligned with the South Carolina state standards for the appropriate grade levels. Includes standards-based inquiry questions to lead students through explorations of the topic discussed. Curriculum Connection is available on-line at www.scseagrant.org/education.